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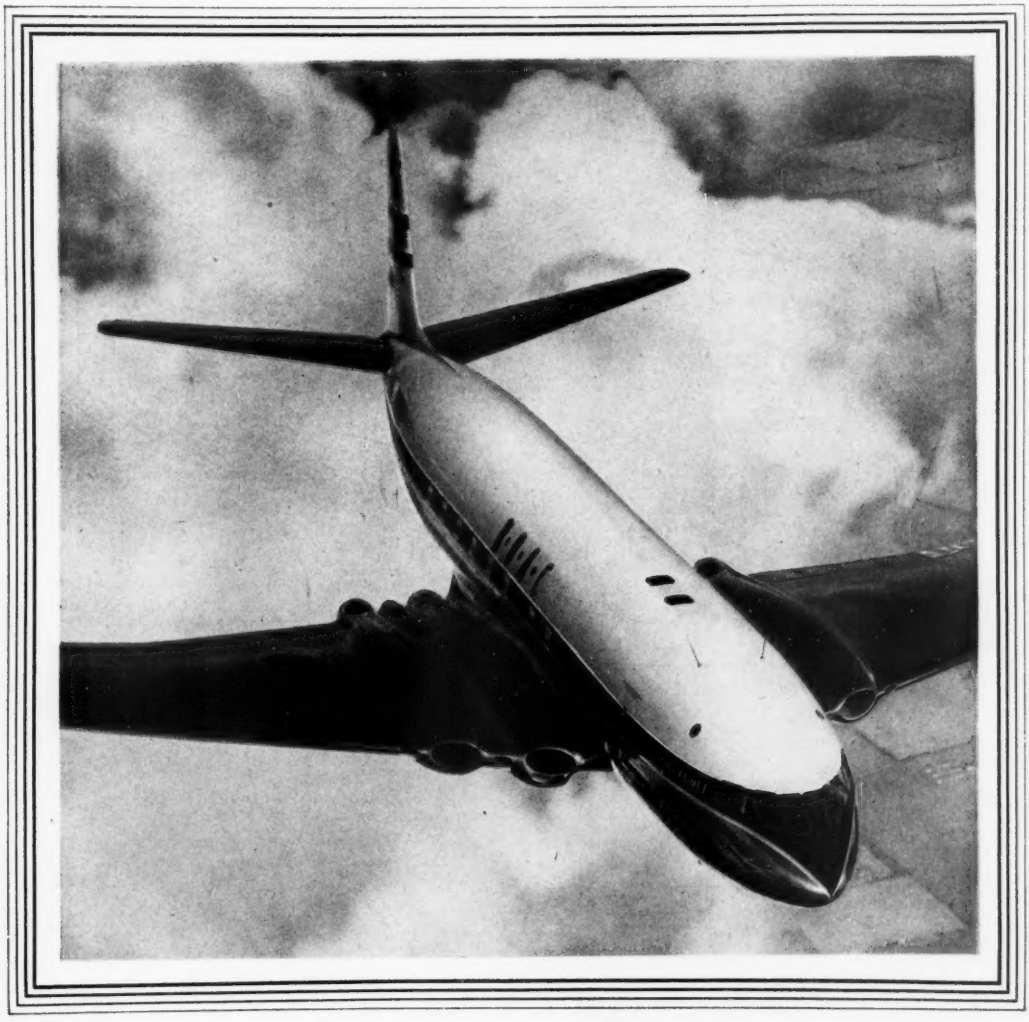

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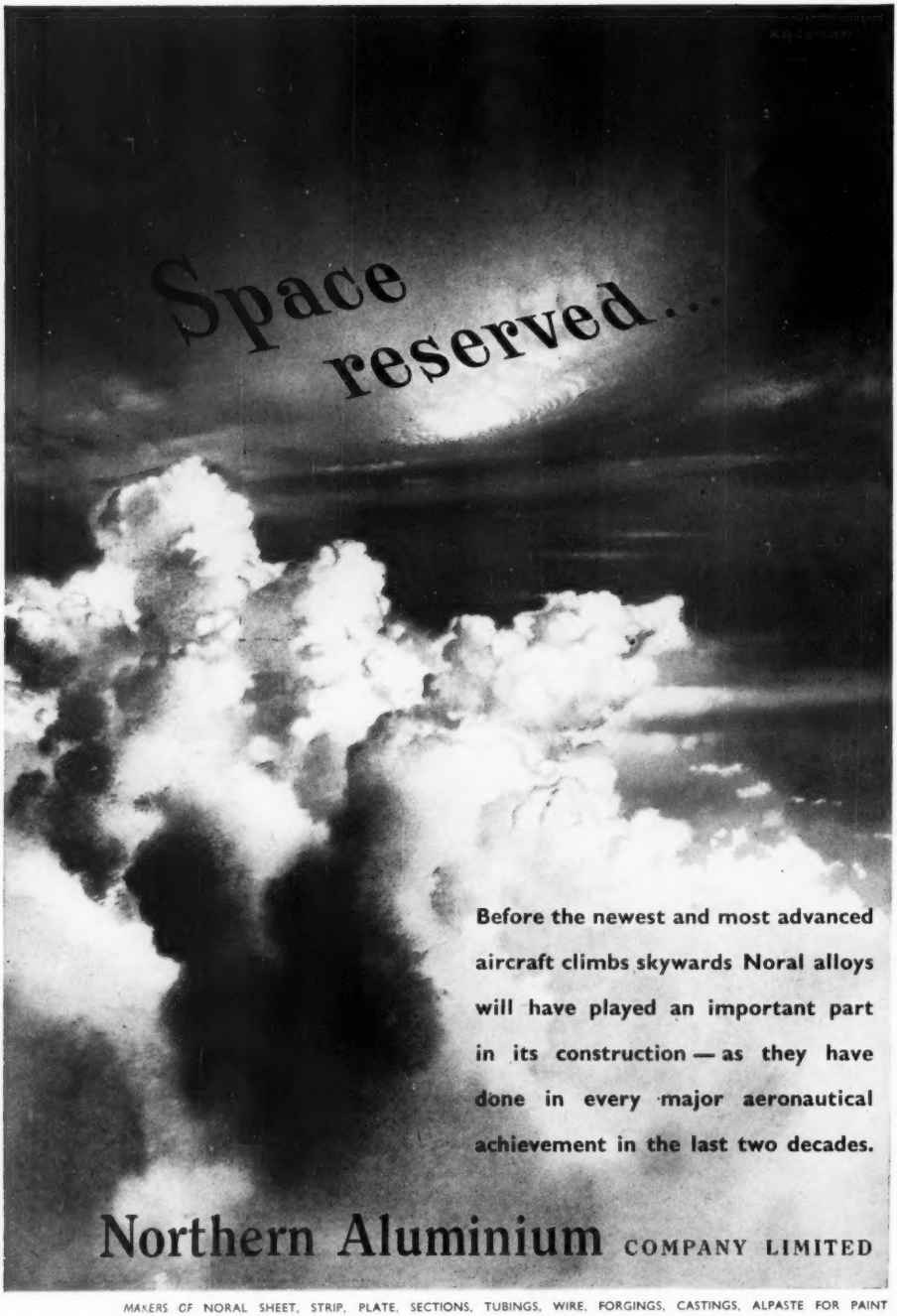
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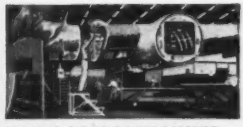

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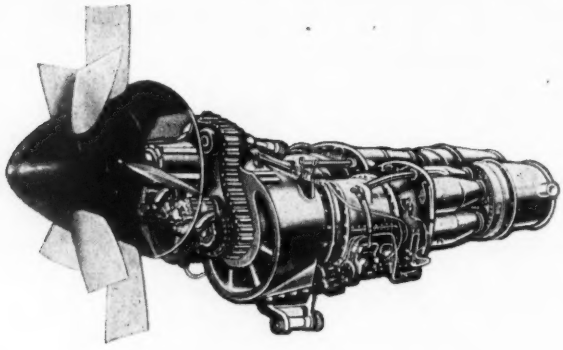

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Founded 1909

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Not So Black . . .

IN the highly competitive—and therefore highly sensitive—business of air transport it is all too easy to put the proverbial cat among the pigeons by indulging in discussion of such a delicate subject as the late delivery of replacement aircraft. One can expect both fur and feathers to fly. When, however (as was recently the case), a leading national newspaper's highly disparaging remarks about B.E.A.'s wait for its fleet of Airspeed Ambassadors publicly produce neither fur nor feathers we become curious as to the reasons for such lack of reaction.

Could it be that the charges were unanswerable? Or that feelings had been hurt beyond the possibility of retort? Or that the criticisms as voiced were considered to be so ill-founded as to be unworthy of comment? Clearly, none of these theories fits the case completely, though each may have some bearing on it. In order that our own readers, at least, may be helped to see the matter in its true perspective, we think it desirable to repeat here the facts as they stand.

Contrary to the newspaper's allegation, the twenty Ambassadors on order were *not* all scheduled for delivery ten months ago. The agreement was for five before the end of 1951, the remainder to come off the production line progressively in 1952. (Admittedly, the paper concerned later published a correction of its original statement on delivery dates, but an erroneous impression of the performance of the machine and of its radio equipment was allowed to remain.) Far from being "useless," as the report said, the radio equipment is merely suffering from a certain amount of interference which, it is confidently expected, will be overcome by correct aerial positioning and screening. So far as the power units are concerned, the fact that cooling-drag losses are greater than was originally estimated has meant that, pending modifications, cruising performance is reduced by about 7½ per cent.

This, however, in no way affects the Ambassador's ability to operate with full load from existing runways—even in summer conditions—at any of the South European capitals which the Corporation now serves. In point of fact, the three Ambassadors of which B.E.A. now hopes to take delivery in December would initially operate with unaltered engine-cooling arrangements. Nevertheless, the engine division of the Bristol Aeroplane Co. Ltd., which manufactures the Centaurus 661s used in the Ambassador, is now at work on the cooling-drag problem. The installation, in any case, is such that the engines are, at the moment, *over*-cooled in the cruising condition, so the problem is obviously not insurmountable. A number of minor teething troubles, concerning windscreen-wiper operation and nosewheel emergency gear, are also being attended to.

B.E.A.'s Enthusiasm

The regrettable fact remains, of course, that delay has occurred in the delivery of the first machines, and B.E.A. is not exactly happy about the loss in revenue which has resulted; there, however, so far as the Corporation is concerned, the case rests.

The delay can best be explained, perhaps, by the fact that Airspeed, a small firm of limited resources, was tackling an ambitious project which at times was probably a little beyond its capacity. That success has been achieved at all—intentionally without material help from the production-preoccupied de Havilland parent company—is a matter for congratulation. It is to be hoped that discouraging statements such as the one in question will result in no slackening of the Airspeed team's efforts. Any such loss of morale might, of course, be counterbalanced by the enthusiasm of B.E.A. for its new equipment, of which Peter Masefield says, "it is a damned fine aircraft; we like it; we believe in it . . . I am confident the Ambassador will be able 'to see the pants off' any other comparable aircraft in the world."

B.E.A. not only believes in the Ambassador, but also entertains the hope that at a later date the type will be developed by the fitting of turboprops, and, furthermore, that passenger capacity will be increased to 70 by extending the fuselage. The de Havilland company, we think, would welcome such a course; but because of the sad state of the world to-day, the decision to follow it can emanate only from political brains.

R.C.A.F. in BRITAIN AGAIN

R.A.F. Hands Over North Luffenham to the Canadian No. 1 Fighter Wing

FOR the past year No. 421 (Red Indian) Squadron, R.C.A.F., has been stationed at Odiham, Hants, and operating under Fighter Command. On Thursday of last week a further stage was reached in the establishment of Canada's promised eleven-squadron air group to be based on this side of the Atlantic, when No. 1 Fighter Wing, R.C.A.F., took over from the R.A.F. the station at North Luffenham, Rutland.

The handing-over was observed with due ceremony, the High Commissioner for Canada, the Hon. W. D. Wilgress, and the Vice Chief of the Air Staff, Air Chief Marshal the Hon. Sir Ralph A. Cochrane, being present. Air Marshal Sir Basil Embry, A.O.C.-in-C. Fighter Command, was unable to attend; he is now touring fighter stations in Canada. A number of senior officers from Fighter Command and Flying Training Command watched the ceremony.

Extremely bad weather caused the parade to be held in one of the hangars; even so, until the windward doors were closed, the airmen were getting very wet.

The High Commissioner and Sir Ralph having arrived, the ensigns of the two Services were broken to the accompaniment of the appropriate trumpet calls and the Canadian guard of honour was inspected. In attendance on the High Commissioner was G/C. E. B. Hale, D.F.C., R.C.A.F., who is the new station commander, and the Vice-C.A.S. was attended by G/C. R. A. Ramsey Rae, O.B.E., the R.A.F. station commander. White-belted and white-gloved, the Candians looked very smart, and it must be admitted that the bereted R.A.F. contingent suffered by comparison, both in dress and bearing.

At the end of the inspection a table was set before the dais and on it was placed the document conveying the station from the possession of the R.A.F. into that of the R.C.A.F. It was signed by both G/C. Hale and G/C. Rae.

"Flight" photograph

G/C. E. B. Hale, D.F.C., R.C.A.F., signs the document placing North Luffenham in the charge of Canada. G/C. R. A. Ramsey Rae, O.B.E., R.A.F., who is seen looking on, also signed.

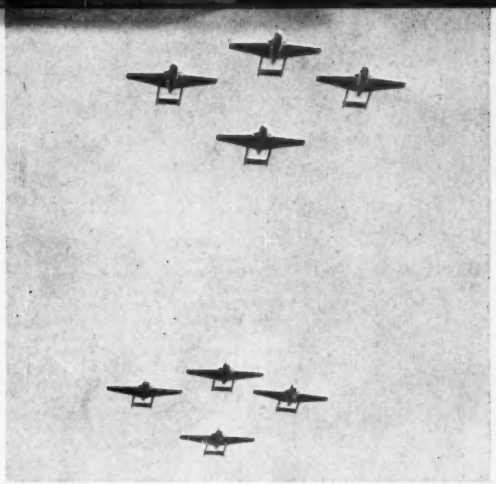
The handing-over completed, the assembled company was addressed by the Hon. W. D. Wilgress. He not only voiced Canada's thanks for the use of the station, but also gave a brief history of No. 410 (Cougar) Squadron, which will be the first Canadian squadron to be stationed at North Luffenham. In the course of his speech he said, "I wish to express to the United Kingdom authorities, on behalf of the Canadian Government, our sense of deep appreciation and gratitude for making possible the ceremony we are witnessing today. The handing over of the station by the R.A.F. to the R.C.A.F. symbolizes the close co-operation which has characterized these two services ever since the R.C.A.F. was formed.

"North Luffenham will be the first Canadian Air Force station in the British Isles since June, 1946. It is therefore a sign that we recognize once more the need to be fully prepared to defend ourselves. It is for the defence not only of these islands, but of the whole North Atlantic community, that No. 1 Fighter Wing of the R.C.A.F. is to take over control of this station. In doing so, I am confident that they will maintain fully the high traditions of this station, which in the ten years since it was opened has secured for itself an honoured place among many renowned air stations of the neighbourhood. We consider ourselves fortunate indeed to have had assigned to us this North Luffenham station.

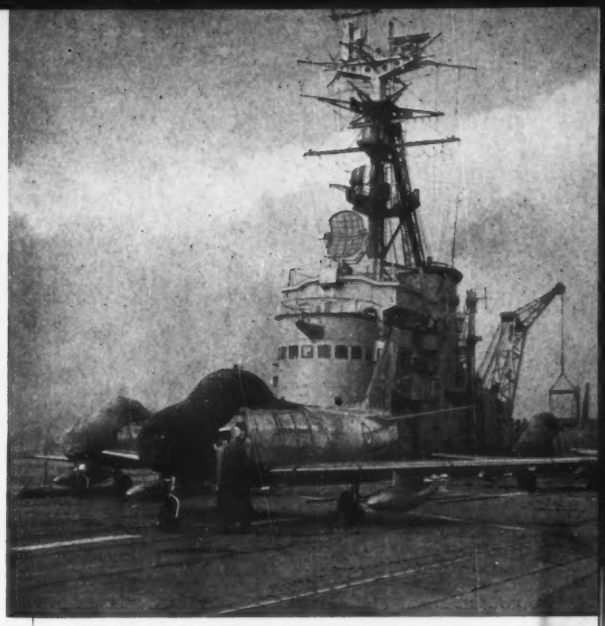
"It was from here that two heavy bomber squadrons operated for some months in 1941 and 1942. Later it was used by an operational training unit. Then for a period the station was occupied by the Air Support Division of the United States Air Force. In the latter stages of the war, it was again used by a training group of Bomber Command. Since the war North Luffenham has been operated by Transport Command, until Training Command took over early in this year and used it as a Flying Refresher School. The station will now demonstrate once more its capacity for varied usefulness by being the headquarters of No. 1 Fighter Wing of the Royal Canadian Air Force.

"The first Canadian squadron to take up station at North Luffenham will

The Hon. W. D. Wilgress, High Commissioner for Canada, addressing the assembled company. Sir Ralph Cochrane is on the left.
"Flight" photograph



Two sections of No. 421 (Red Indian) Squadron during the fly-past. On returning to Canada, No. 421 will leave its Vampires behind.
"Flight" photograph



Right Preparing the Sabres of No. 410 (Cougar) Squadron, R.C.A.F. for off-loading from the flight deck of H.M.C.S. "Magnificent."

be No. 410 (Cougar) Squadron of the R.C.A.F., which disembarked yesterday from H.M.C.S. *Magnificent* at Renfrew, Scotland. As the representative in this country of the Canadian Government, I wish to extend to the squadron a most hearty welcome to the station which will be their headquarters during the period they will be stationed in the United Kingdom. Early next year, two more R.C.A.F. fighter squadrons will arrive from Canada, and No. 1 Fighter Wing will then be up to strength.

"It is fitting that the first Canadian squadron to be stationed at North Luffenham should be the one which has traditions fully in keeping with those of the station itself. No. 410 (Cougar) Squadron was first formed at Ayr, Scotland, on June 30th, 1941, as a night fighter squadron. Later it won the distinction of being the top-scoring night-fighter unit of the Second Tactical Air Force during the period from D-Day to V.E. Day. Its records show that the squadron's Beaufighter and Mosquito crews were credited with 75 enemy aircraft destroyed, two probably destroyed and eight damaged. Of these 85 successes, 60 were won in the eleven-month period between June, 1944 and the end of April, 1945."

Mr. Wilgress might have added another note of historical interest: that it was a pilot of No. 410 who made one of the unique "kills" of the war. On the eve of D-Day, at about 11,000ft over Caen, this Canadian pilot saw something the like of which he had never seen before—a Ju88 with an Me109 mounted on its back. He shot the composite aircraft down. (The Junkers was packed with high explosive and controlled by the Messerschmitt, which released it to glide to its target.)

After referring to the squadron's disbandment in 1945 and its training since it was re-formed three years later at St. Hubert, Quebec, the High Commissioner turned to a more general theme.

"Canadians," he said, "intend to carry out the obligations which we have assumed under the N.A.T.O. It is an important stage in the fulfilment of these obligations that we are participating in today. This ceremony represents the first passing to the control of the R.C.A.F. of a number of stations on this side of the Atlantic. Later on bases will be provided from which Canadian airmen will operate as an integral part of the forces under the command of General Eisenhower. It is fitting that before proceeding to these bases the Canadian airmen should first take possession of a station handed over to Canadian control by the R.A.F., with which the R.C.A.F. has had such a long and close association."

Air Chief Marshal the Hon. Sir Ralph also addressed the parade. "Our thoughts for the last five weeks," he said, "have been much in Canada and it therefore seems especially appropriate that it should be at this time that we are welcoming No. 1 Fighter Wing of the Royal Canadian Air Force to this country." He went on to say, "In occupying this station the Wing will assume responsibility for an important sector of the air defence network, a post of honour which we are happy it should occupy."

After lunch there was a short flying display, which it had been hoped would be given by No. 410 on their Canadian-built Sabres. Unfortunately it was found impossible to off-load them from the *Magnificent* in time for the show, but No. 421 from Odiham put up a splendid performance in their Vampire 5s. They are much improved since they came to Britain.

W/C. R. T. P. Davidson led the squadron for the last time. The unit is now in the process of returning to Canada to be re-equipped with Sabres, but he is remaining in Britain to become Chief Operations Officer (Wing Commander Flying) at North Luffenham.

The twelve Vampires took off in pairs, roughly nine seconds separating each pair. Against the now blue, almost cloudless sky, they returned in three vics, line abreast, with one Vampire in each box. For the next pass the same formations were kept, but in line astern. The third fly-over was, however, easily both the best and most exciting. For this they approached the airfield rather higher, the Vampires formating in three perfect echelons to starboard. Over the centre of the runway they made a quick peel-off to port—each in turn flying low towards the control tower and banking steeply past in salute to the High Commissioner and Sir Ralph Cochrane, who were in the control room. One of the Vampires had to force-land, only just making the end of the runway. Apparently, for some reason, its Goblin could produce only 7,000 r.p.m.

In formation again, the remaining eleven Vampires returned to the airfield making another high-speed peel-off —this time to fly a down-wind half-circuit before landing. The landing was as expeditious as the take-off. At one period there was as many as nine Vampires on the runway at once. Although none of the Sabres put in an appearance, a number of No. 410's pilots were present at the ceremony. Many of them were looking very weary after a rough crossing of the Atlantic, plus an all-night bus ride from Glasgow to North Luffenham. They appear to be pleased with the Sabres but have not done sufficient operational flying with them to judge whether they are better than the Vampires for air-to-air firing at their operational ceiling. They are pleased with the finger-lightness of the F-86's powered controls but, at the same time, say this ultra-lightness, plus a slow throttle response, makes formation flying difficult work. They have brought with them 48 Sabres, 37 of which travelled in the open on the flight deck of H.M.C.S. *Magnificent*.

SIGNING-OFF: Their Royal Highnesses Princess Elizabeth and the Duke of Edinburgh sign the guest log-book of the Royal Canadian Air Force C-5 (Canadair North Star) in which they journeyed 4,200 miles round Canada without incident and to a split-second schedule. These two exceptionally fine portraits of the Royal couple are the work of F/O. L. Walker, photographer in the R.C.A.F. Public Relations Branch.

FROM ALL QUARTERS

Good News?

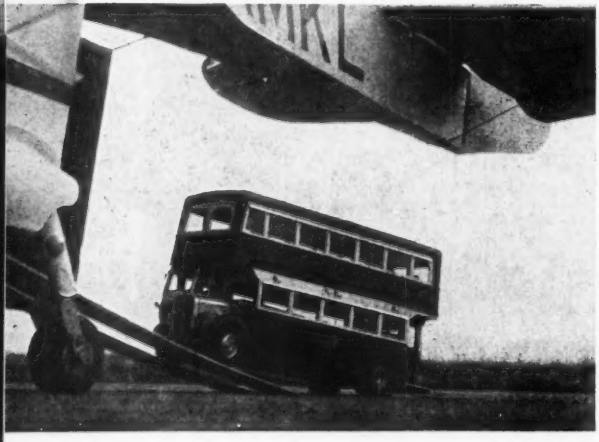
"AN announcement of considerable importance to the future of the flying-club movement" was due to be made yesterday, November 22nd, by Mr. J. S. Maclay, Minister of Transport and Civil Aviation. It was to be given out at a meeting at Londonderry House.

The information that the announcement was to be made was given last week-end by the Association of British Aero Clubs and Centres, and aroused eager anticipation in all concerned. The possibility of a subsidy, or of a total abolition of fuel tax, or both, has long been discussed; whether the news concerned these desirable things, or something altogether different, will be known by the time these words appear.

Overdue

SOME months ago, there appeared in the correspondence columns of *Flight* several strongly expressed opinions on the inadequacy of insurance cover and rates of pay for flying instructors. Now comes news that the Industrial Disputes Tribunal has laid down salary scale and insurance cover minima for pilots and flying instructors at Reserve and basic flying training schools. The order will be retrospective in its effect from June 1st, 1951.

The minimum salary for instructors is to be £750 a year for a probationary period of not more than six months, thereafter rising immediately to £850 with subsequent yearly increments of £50 up to a maximum of £1,050. The staff pilots' scale is £50 less at all levels than that laid down for instructors. Pay for existing staff will be on the basis of length of service with present employers. The insurance minimum both for staff pilots and flying instructors is in the capital sum of £3,000.



New C.F.I. for A.S.T.

A NEW appointment at Air Service Training, Ltd., is announced by the parent company, the Hawker Siddeley Group: Taking over the duties of C.F.I. at Hamble is W/C. H. A. C. Stratton, A.F.C., who for the past 17 months has been chief instructor and general manager of the Royal Pakistan Air Force school at Mauripur, which is also operated by A.S.T.

W/C. Stratton

W/C. Stratton first joined the R.A.F. in 1923, at the age of 18. He qualified as a sergeant pilot in 1927 and was posted to No. 45 Bomber Squadron in the Middle East. In January 1931 he became an instructor at the R.A.F. College at Cranwell. During his time on the staff of the Central Flying School, Wittering (1932-1937) he was a member of the famous C.F.S. inverted formation flying team which provided one of the high-spots at the Hendon displays.

In 1943 he went to Canada to serve as chief instructor and commanding officer of various Service flying training schools, and in 1945 he was appointed to command Shellingford, an A.S.T.-run R.A.F. station.

Demobilized in March 1947, W/C. Stratton went to Hamble, but returned to the Service again, to command of Watchfield, the A.S.T.-operated R.A.F. Beam Approach School, from 1949 to 1950.

He now succeeds S/L. B. R. Tribe, A.F.C., at Hamble; S/L. Tribe has moved to Ansty, near Coventry, as chief instructor at No. 2 R.A.F. Basic Flying Training School, recently established by A.S.T. In the interim between the two appointments, S/L. G. C. Webb, A.F.C., has acted as C.F.I. at Hamble.

JUST A RAMP: Stung to action by our recent publication of a picture showing a motor-coach entering the Blackburn and General Aircraft Universal Freighter, Auster Aircraft have released this striking photograph taken beneath the tail of their "new Gulliver Freighter—hitherto a well-kept secret." The Gulliver's tail unit, it will be noticed, bears a marked resemblance to that of the Auster Ambulance/Freighter. We seem to have seen the double-decker bus somewhere before; could it have been at a model-engineering exhibition?

D. H. Appointments

HAVING resigned his post at the Royal Aircraft Establishment, Mr. C. Chapleo, F.R.Ae.S., A.F.I.Ae.Sc., has joined the Airspeed Division of the de Havilland Aircraft Co., Ltd., and will henceforth be in charge of the stress and structural test departments at Christchurch.

Mr. Chapleo entered the industry in 1924 as a draughtsman with the Fairey company; two years later he went to Blackburns in a similar capacity, then returned to Faireys in 1927, where he was engaged on stress-work on the Fairey long-range monoplane and other aircraft. From 1929 to 1935 he was a technical assistant at Westlands under Prof. (then Capt.) G. T. R. Hill. In 1936 he joined Airspeeds, successively becoming chief stressman, chief technician and chief structures engineer. Thirteen years later he went to the Royal Aircraft Establishment, where, until last June, he was a principal scientific officer in the structures department.

From the Hatfield H.Q. of the de Havilland enterprise comes news that Mr. H. G. Rice, hitherto a member of the public relations department, has been appointed Far East area representative of the D.H. companies; he is now beginning a tour of his territory. We of *Flight*, who have found Hugh Rice consistently helpful during the five years that he has been at Hatfield, wish him well in his new appointment.

Herculean Effort

THE standard engine type-test today is a little different from the erstwhile 100-hour type-test which was for so long the criterion: even so, the 100-hour test was by no means easy—it imposed an acceptance norm which many engines found too high to achieve at the first attempt. That the test was tough by any standards is worth bearing in mind in relation to the impressive performance put up recently by a Hercules 634 at Bristol.

The engine division of the Bristol Aeroplane Company decided to build up an engine from components the great majority of which had already run for over 3,000 hours in Hercules 634 engines from B.E.A. and Airwork Vikings. Having thus conjured an engine from pooled components they subjected it to the 100-hour civil type test—a pretty rigorous demand.

The test was a virtually flawless success; the performance of the engine was, in fact, in every respect within the limits demanded of a new engine today.

Depending on one's familiarity with the vagaries of fatigue, this remarkable performance can mean a great deal or relatively little: by all normal standards, however, it redounds tremendously to the credit of the Hercules and, *ipso facto*, to Bristols. Not the least impressive element of the performance is that it proves beyond doubt the efficiency of Hercules interchangeability.

We were invited by Bristols to inspect the stripped engine: there was nothing at which one could cavil. The only defects were trivial; a sticking ring on one of the junk heads and a minor shift of one of the gudgeon-pin bushes.

Airwork, Ltd., have recently run four of their Hercules 634s through to 1,200 hours and are thus formally applying to the A.R.B. for permission to increase the overhaul period of their 634s from the present 1,000 hour standard up to 1,200 hours. British European Airways are similarly running 12 engines through to 1,200 hours, and it is virtually certain that the Corporation too will apply for, and receive, permission to extend the normal period to 1,200 hours.

BOBSLEIGH: The explanation of this name for the development of the Reid and Sigrist Desford trainer depicted is that the machine is being used for experimental flying with a prone-pilot position. Now VZ728, it was formerly the civil-registered Desford G-AGOS.

Forty Famous Years

BEE, Snark, Snail, Rhino, Sparrow, Duiker, Hippo, Grasshopper, Rainbow, Snapper—all these aircraft were the products of a great British aircraft firm.

Those who pride themselves on their aeronautical history will recognize some of the names, but we doubt whether anyone, other than a few old-timers of the organization concerned, will know them all. Yet every one of these aircraft flew, even if not many reached the production stage.

All of them have, in fact, emanated from the factories of the Hawker and/or (earlier) Sopwith companies at various periods during the past 40 years. The full story of those years—from T. O. M. Sopwith's early experiments to Neville Duke's demonstration of the P.1067 at Farnborough this year—is to be told in a special feature in *Flight* next week, November 30th, an enlarged issue. We venture to think that the story will have a specially strong appeal to ex-R.F.C., R.N.A.S. and R.A.F. pilots who flew the many more famous Sopwith and Hawker types.

Trophy for I.A.F. Technical College

AT a reception at the Indian Services Club in London last Friday, a trophy was presented to the Indian Air Force Technical College by G/C. R. J. F. Barton, O.B.E., managing director and commandant of Air Service Training Ltd. It was received on behalf of the College by Mr. V. K. Krishna Menon, High Commissioner for India.

The College, which is at Jalahalli, near Bangalore, was founded by Air Service Training and is managed and operated by them under contract to the Government of India. The College gives I.A.F. technical officers and apprentices the specialist training necessary to fit them for their Air Force duties. Opened in July, 1949, the College is commanded by G/C. John Beaumont, O.B.E., A.F.C., who has been with A.S.T. since 1933.

A.S.T. is not only responsible for the efficient operation of the College, but also for training Indian personnel so that, after three years, the British instructional staff can be gradually relieved by Indian instructors, and that after five years the Indian Air Force will be in a position to take over completely.

The trophy bears two inscriptions. On the front are the words: "The Barton Trophy for the Best All-Round Apprentice of the Entry"; on the reverse side is: "Presented to the Indian Air Force Technical Training College by the Directors of Air Service Training, Hamble, Southampton, England."

FOR INDIA: G/C. Barton (left) presents his Trophy to Mr. Krishna Menon, who received it on behalf of the Indian Air Force Technical College (see above). On the right is A.V-M. G. E. Gibbs, who has been appointed C.A.S. and C-in-C. of the Indian Air Force.

HERE AND THERE

E. C. BOWYER PRESSES THE BUTTON—and starts a J-47 turbojet in one of the test-houses at the General Electric, Lynn River, Mass., plant. The photograph was taken during the recent tour of U.S. and Canadian factories made by S.B.A.C. members at the invitation of the U.S. Aircraft Industries Association. On the left of the S.B.A.C.'s director is his A.I.A. opposite number, Admiral D. C. Ramsey, U.S.N. ret.; to the right are C. W. La Pierre, G.E. gas-turbine general manager, and Philip Whitmore, i/c engine testing at Lynn River.

Foxy

A HINT in the current *De Havilland Gazette* leads us to suppose that the name Vixen is in mind for the D.H. 110 night and all weather fighter (two Rolls-Royce Avons).

Möhne Dam Film

FILM rights in Pauls Brickhill's book *The Dam Busters*, have been acquired by Associated British Picture Corporation. Production is to begin at Elstree early in the new year.

Fuel is Where You Find It

SHORTAGE of metal containers in Northern Australia is making salvage of ex-war petrol and oil drums a paying proposition. Tens of thousands of drums abandoned by the Allied Air Forces in the Northern Territory are being recovered, and in many instances have been found still to contain high-octane spirit; some 84,000 gallons has already been found. Abandoned R.A.A.F. landing strips in the Gulf of Carpentaria region are being thoroughly combed, and a shallow-draught landing craft has recently left Melville Bay with a cargo of two thousand full drums and four thousand empties.

Pathfinders Sold Out

ALL tickets for the Pathfinder Club's annual ball, to be held at the Dorchester, London, on Saturday, December 1st, have now been sold. Among the principal guests will be Air Marshal Sir Thomas Williams, Inspector-General of the R.A.F., and Sir James H. Barnes, Permanent Under-Secretary of State for Air. Mr. Richard Todd, who is play the part of W/C. Guy Gibson in *The Dam Busters* film (mentioned in column 1) will also be present.

Price of Preparedness

ADDRESSING the Air Industries and Transport Association in Quebec recently, Mr. J. H. Parkin (director of Canada's newly created National Aeronautical Establishment), lamented the fact that civil-aircraft design in the Dominion was suffering as the result of concentration on military production. "Our aeronautical talents seem d dicated to rearmament," he is reported as saying, "and as a result, there is a very serious lack of planning for civil aviation."

Gas-turbine Tanker

THE new 12,000-ton Shell tanker *Auris*, powered by a B.T.H. gas turbine, recently made her first working trip to Tampico, in the Gulf of Mexico, to load oil.

Mercy Mission

LAST Sunday night an R.A.F. Lancaster flew from Malta to drop food supplies and rubber dinghies to the people marooned by the diastrous floods in the Po Valley, Italy.

Hotting It Up

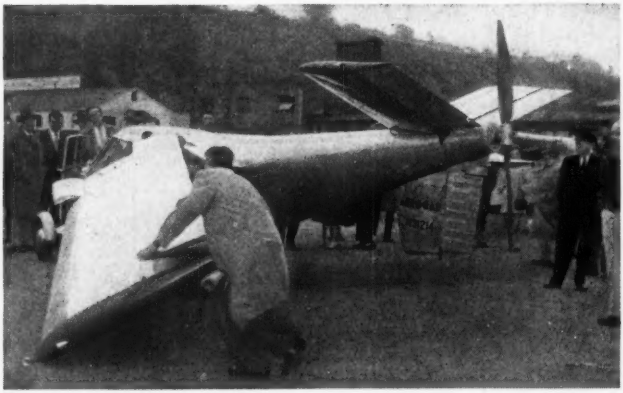
REHEAT is to be applied to the Orenda power unit (which already gives over 6,000 lb static thrust) of the Avro Canada CF-100 all-weather fighter. A contract has been placed with the Solar Aircraft Co. (California and Iowa) for the necessary equipment, but a considerable period will be required for development.

U.S.A.F. at Prestwick

A STAGING-POST of the European Wing of the U.S. Military Air Transport Service has been established at Prestwick Airport, under the command of Col. Lawrence S. Lightner, an ex-8th Air Force pilot. The first unit handled was the 126th Bombardment Wing, Air Tactical Command, a number of whose aircraft and crews left recently, after a short stay, for an airfield near Bordeaux.

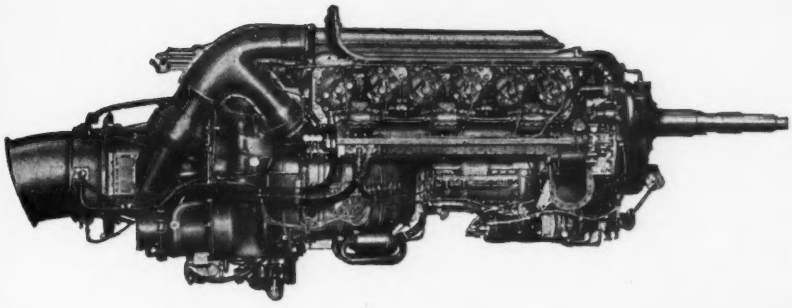
Airline First-aid

AT the request of a civil-aviation operator, a special first aid course for airline crewmembers (including hostesses) is being held under the direction of the St. John Ambulance Association at St. John House, 15-16 Collingham Gardens, London, S.W.5 (Frobisher 2845). It begins at 2 p.m. tomorrow (Saturday, November 24th) and will end with an examination on the following Friday; lectures are to be given by the Surgeon-in-Chief of the St. John Ambulance Brigade. The fee for the course is the modest one of ten shillings.



BREAKING IT DOWN: Moulton B. Taylor, designer of the "roadable" aircraft built by Aerocar, Inc., of Longview, Washington, makes the transition from air to road—the work of a few minutes. The pusher airscrew, behind the butterfly tail unit, is driven by a 125 h.p. Lycoming engine. A 190 h.p. military "flying jeep" is now in preparation.

NAPIER



NOMAD

Nomad — the world's finest composite aircraft engine. Half diesel, half gas turbine, the Napier Nomad delivers 3000 h.p. to contra-rotating propellers with a specific fuel consumption unapproached in aviation. The Nomad is the latest manifestation of the engineering skill and practical originality of outlook which through more than fifty years have enabled Napiers to build outstandingly successful engines for air, land and water transport.

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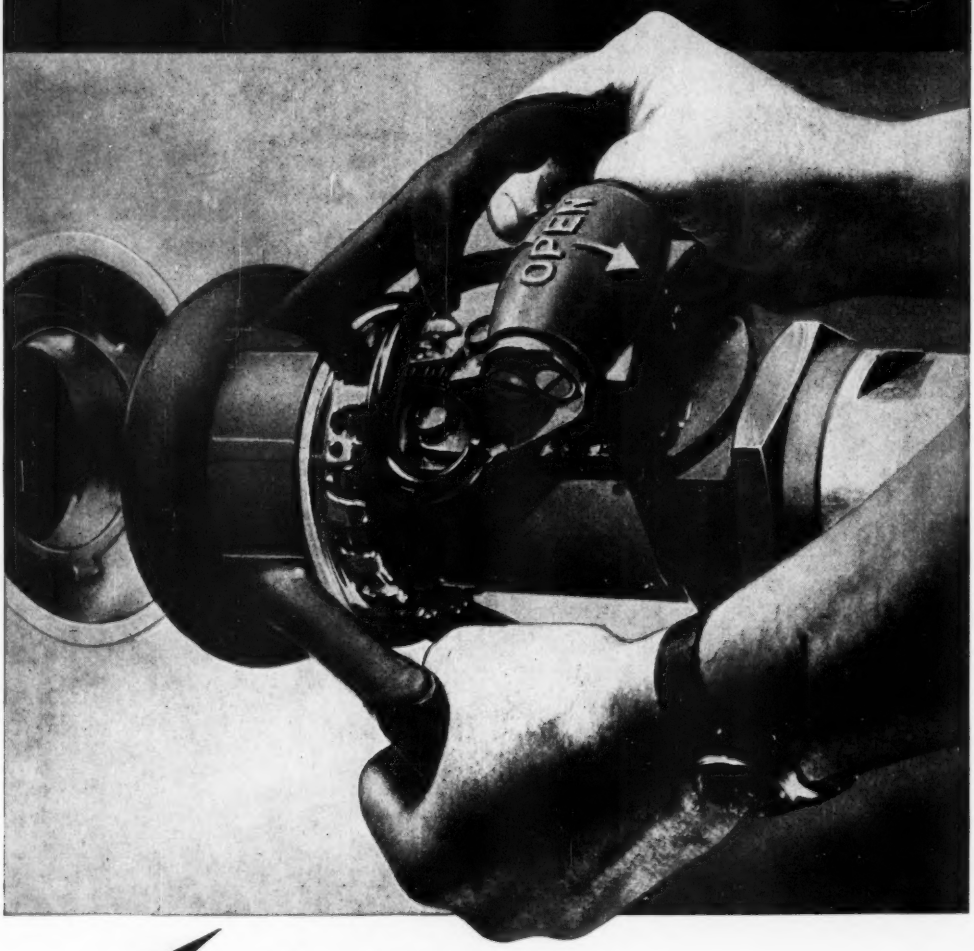


More time in the Air . . .

Less time on the ground . . . with the

F.R. HIGH SPEED SYSTEM

FLIGHT REFUELLING LIMITED,
TARRANT RUSHTON AIRFIELD, BLANDFORD, DORSET.

REFUELLING VALVES—FLOAT SWITCHES—PIPE CONNECTORS—GROUND COUPLINGS. Contractors to the British and United States Governments.

U.N. TYPES: A striking series of portraits received last week from the Korean War theatre. Left to right are Capt. Johnny O. Crowell, U.S.A.F. Mustang pilot; Capt. Michael Parker, S.A.A.F. (No. 2 Sqn.) Mustang pilot, who flew Spitfires in Hitler's War; Maj. Paul L. Carlisle, U.S.A.F. F-80 exponent; and Col. William T. Halton, F-84 pilot and commander of 136th Fighter/Bomber Group, U.S.A.F. The modern "crashproof" headgear is, we believe, more comfortable than it looks.

HERE AND THERE . . .

Turboprop Trainers

THE U.S.A.F. has contracted with Consolidated-Vultee for the supply of a number of T-29 trainers (developed from the Convair 340 and filling a similar rôle to the Varsity), powered by Allison T-38 turboprops. The top speed, it is estimated, should be at least 350 m.p.h.

All Mod. Con.

SHOWN on this page is a Horsa glider fuselage in use as a week-end bungalow at Hayling Island, Hants. The complete aircraft, says a correspondent, was bought as war surplus for £25; it had apparently seen active service, for the cockpit contained maps of the Low Countries and the cabin showed signs of Army occupation. A neat job has been made of the conversion and, to keep an aeronautical atmosphere, as many as possible of the original fittings have been retained. The "living" portion of the cabin contains two settees which convert into single beds, and rubber-foam seats on either side of the dining table combine to form a double bed. In the glazed nose (the "lounge") the cockpit seats have been retained. A second Horsa nose has been attached to the aft end of the fuselage to serve the purposes of a kitchen.

HORSA HOME: A glider fuselage as a week-end bungalow at Hayling Island (see paragraph "All Mod. Con.").

IN BRIEF

THE Under-Secretary of State for Air, Mr. Nigel Birch, M.P., has appointed Sir Edward C. G. Boyle, Bt., M.P., as his parliamentary private secretary and Mr. R. J. Penney as his private secretary.

* * *

Recently elected to the board of the Bristol Aeroplane Co., Ltd., Air Chief Marshal Sir Alec Coryton has now begun his duties as divisional managing director of the company's engine division.

* * *

Under the sponsorship of the Economic Co-operation Administration, Mr. Douglas Lewis, of Short Brothers and Harland, Ltd., is now taking a post-graduate course at the University of New York. Mr. Lewis, who is stated by the company to have shown "outstanding technical ability," has been in charge of a "special investigation scheme" in their research and testing department. He is the son of Mr. P. S. Lewis, development superintendent.

* * *

W. S. Shackleton, Ltd., the aeronautical consultants and suppliers, announce that Mr. Keith Shackleton has been appointed a director.

* * *

An extremely useful little English-French dictionary of aviation technical nomenclature and units has been prepared by the S.B.A.C. It includes many terms, particularly those used in design and in commercial operation, not ordinarily found in technical dictionaries.

COLLECTED: Capt. "Jock" Cameron, B.E.A. helicopter pilot, recently went to Filton (as reported last week) to take delivery of a Bristol 171 for development flying at Peterborough. He is seen taking over the helicopter from Bristol assistant chief test pilot Ronnie Ellison.

Aeroservices Ltd., are now in new London headquarters at 46 Hertford Street, W.1.

* * *

The Northern Heights Model Flying Club is to hold its annual dinner and dance at the Windsor Castle Restaurant, London, S.W.1, next Thursday, November 29th. Several people prominent in aviation have accepted invitations.

* * *

The Burmah Oil Company and the Shell Group, the two partners in Burmah-Shell India, are considering the erection of a refinery at Bombay. Discussions are taking place in Delhi with officials of the Indian Government.

* * *

The chilliness of airfield tarmac in winter is quoted by Manfield and Sons, Ltd., as a good reason for wearing their latest men's sheepskin-lined ankle-boots, available in ordinary or suède leather. Prices range from 79s. to 98s.

* * *

Flight regrets to learn of the death, at the early age of 42, of Mr. Alan Sinclair, managing director of the British Tyre and Rubber Co., Ltd., and of the associated Silvertown Co. He had spent the whole of his business life with the organisation.

By
E. A. G.
RUMBELOW

"Smart and speedy" is the impression gained on first seeing the Minicab, France's fastest and cheapest ultra-light aircraft. ("Flight" photograph)

MINICAB in the Air

Excellent Performance of an "Under 500kg" Two-seat Trainer/Tourer

IN last week's issue mention was made of the pleasing design and practical layout of the SIPA 90 series of two-seat civil trainers, which have been delivered in quantity as basic-training equipment for many French flying clubs. As it affords the opportunity of an interesting comparison, the Béarn Minicab has been chosen as the object of this week's "In the Air" impressions; and if, on comparing the two reports, the reader is surprised by a strong similarity, it should be realized that although not from the same stable, the Minicab and the S.90 series have a certain kinship. They are, in fact, both from the board of the same designer, M. Y. Gardan, who, after seeing his S.90 win the French Air Ministry's competition in 1948 for light two-seaters in the 75 h.p. category, left the SIPA factory to become Technical Director of *Constructions Aéronautiques du Béarn*. The Minicab thus inherited much of the S.90's design philosophy, although, in this instance, the same basic concept has emerged in a lighter, cheaper and less powerful (yet slightly faster) package.

The prototype made its first flight in 1949, was awarded its *Certificat de Navigabilité* fifteen days later and has since gone into limited series production. Having already sampled one of M. Gardan's *chefs d'oeuvre* I was particularly interested to find out whether his obviously sound ideas on light-aircraft design would show up to the same advantage on a smaller machine. With this object I borrowed a SIPA 902 from Villacoublay to visit Buc airfield, where I was fortunate enough to be able to fly the actual Minicab in which, on July 25th, M. Rébillion had created a new world distance record for aircraft in F.A.I. Category I (under 500 kg). Using an auxiliary tank fitted in place of the passenger seat, he flew some 1,826 km non-stop from Paris to Rabat-Salé, in North Africa. Even without additional fuel reserves, the low specific consumption of the Minicab's 65 h.p. Continental engine gives the machine a still-air range of 750 km (470 miles), a useful improvement on the 450 km range of, for example, the S.902.

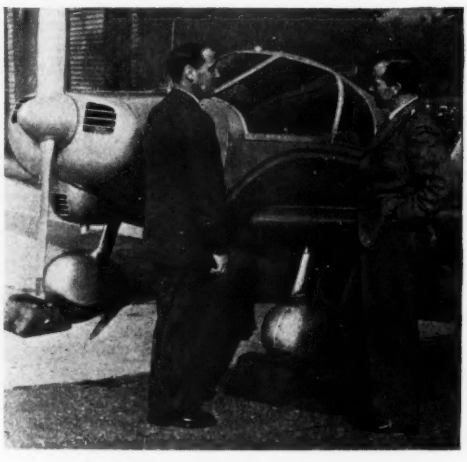
While not possessing quite the same degree of shapely elegance as its near-relation, the Minicab is characterized, perhaps, by more rakish and plainly functional lines. From the dimensional viewpoint it is, overall, a slightly smaller aircraft, and structure weight has been saved wherever possible by using fabric covering instead of plywood. Other economies have been effected by eliminating such refinements as oleo-pneumatic undercarriage shock-absorbers, hydraulic brakes and an engine starter. The wing, which is of the cantilever "one-piece" variety, with one main and one auxiliary spar, is attached to the fuselage by four bolts; slotted ailerons are fitted. The fin is integral with the fuselage and the ply-covered tailplane is attached in the same manner as the wing. Elevators and rudder are fabric-covered and a trim tab is fitted on the starboard elevator only. The cantilever undercarriage legs are fitted with rubber-block springs and are fully faired.

Power, as already indicated, is provided by a 65 h.p. Continental A-65 four-cylinder, horizontally opposed, air-cooled engine, driving, normally, a Merville fixed-pitch two-blade wooden airscrew of 1.64m (5ft 4in) diameter. On the machine I flew, however, a coarser-pitch airscrew had been fitted for the record-breaking flight. The engine is fed from a 11-gallon fuselage fuel tank, the direct-reading float gauge of which is mounted in front of the windscreen. Altogether, the saving in weight amounts to about 250 lb and the Minicab's power loading—for a 65 h.p. engine—is roughly the same as that of the 85 h.p. S.902. The weight reduction does, of course, imply a certain loss of ruggedness; but, as the aircraft falls within the ultra-light category and is not primarily a trainer, its duties are obviously likely to be somewhat less exacting.

For sheer neatness the cockpit would be hard to beat, and although it is not quite as spacious as that of the SIPA, its occupants are certainly not cramped. There is adequate leg-room and the well-padded side-by-side seats are comfortable. Visibility is, if anything, better than that in the S.902, especially over the nose. The combined upward-opening Rhodoid windscreen and roof-fairing may be jettisoned in emergency; this neat enclosure is locked by a handle on the roof. The "swept" windscreen should also be specially useful for ensuring good visiblity in rain.

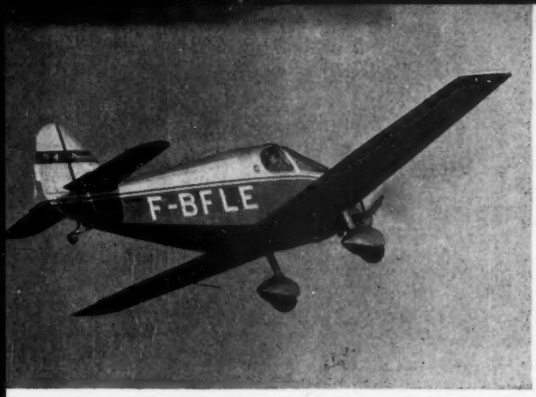
The dual control-column is of an unusual "forked-stick" pattern and although it seemed to do the job perfectly well I must confess that I found it a little disconcerting to be waggling a small handle which was not directly connected to the floor. Rudder controls are conventional, and the left-side set is fitted, Auster fashion, with heel-brakes. The general finish of the cabin is probably more sumptuous than on many larger types.

It would be impossible to have a simpler instrument panel than that fitted in the Minicab. It consists merely of a centrally mounted r.p.m. indicator with an A.S.I. and altimeter on its left



"Flight" photograph

Before the test-flight, M. Rébillion (left), holder of the world's distance record in F.A.I. Category I, discusse his machine with the author.



Lively but well-balanced controls make the Minicab a pleasure to fly. Even near its stalling speed the machine is unusually agile.

and right respectively. A Pioneer-type compass, oil pressure and temperature gauges, and a bubble-type bank indicator complete the picture. There is adequate baggage space behind the seats.

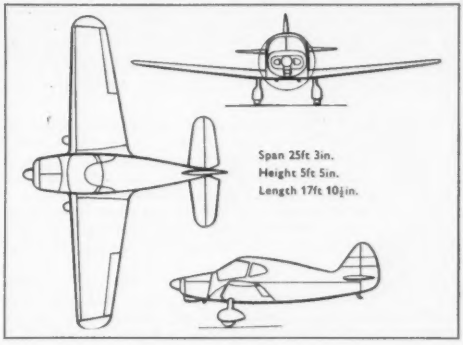
Starting the engine involves simply operating the combined injection and main tank fuel cock (found below the instrument panel), selecting both magnetos "on" and manually swinging the airscrew. The warm-up is carried out at 1,000 r.p.m. until the oil temperature reaches 40 deg. C. Magnetos are checked at 1,500 r.p.m. and at full throttle the engine should give 2,000 r.p.m. on the ground. In taxying, the Minicab shows good response to rudder (which is interconnected with the tail-wheel) and the brakes need rarely be used. They are, in any case, only mechanical and, as is usual with simple braking systems of this kind, a certain tendency to "snatch" is apparent.

Among the Minicab's most attractive qualities are its excellent take-off and initial climb—so unlike the wind-wafted, labouring efforts which all too often seem to characterize ultra-light aircraft. When the throttle is opened the tail rises quickly and, as the rudder is fully effective almost at once, the machine answers the pedals beautifully and during its remarkably short run shows only a slight tendency to swing to port. Using take-off flap, which is selected on a gated quadrant by an easily found lever on the left-hand side of the cockpit, "unstick distance" is only about 140 yd in zero wind. For take-off, also, the elevator trimmer (located beneath the mag. switches) should be placed in the *cabré*, or tail-heavy position; I thought it was rather more effective than that of the SIPA. From the moment the wheels unstick—at about 76 km/hr—the pilot is aware of well-harmonized and incredibly light controls. So light are they, in fact, that an initial tendency to over-control must be watched.

The initial rate of climb is very good at 2,300 r.p.m., being of the order of 3 m/sec (about 600ft/min). In normal flight the Minicab seems completely stable in all planes, and stick and rudder loadings at normal speeds are very light. Lateral and directional control is good down to as low as 85 km/hr with half flap. Speed variations following angle of attack changes are fairly rapid in their onset and, in a dive, the stick loading, although well within tolerance, seems to build up quickly. The *Vne* limit is about 260 km/hr and although the machine has been loaded to 4½g on test, no aerobatic manoeuvres are permitted. The strength factor is, nevertheless, high, and turbulence is therefore not likely to be a source of worry in this respect.

Steep-turns and stall-turns are a delight to perform because of the positive "feel" which is retained right down to stalling-speed. If pulled really tight on the turn, the Minicab will go round in a 50-yd radius. The stalls themselves, in various configurations, are equally straight and innocuous and result in only a small loss of height. Recovery follows instantly on the release of back-pressure and a spin is difficult to produce unless harsh rudder is applied with aileron. I noted the stalling speeds as being: no flap, 75 km/hr; half flap, 72 km/hr; full flap, 70 km/hr, and was also impressed by the way in which the aircraft tends to retain its longitudinal stability throughout the speed-loss range.

In the cruising condition (i.e., at 2,150 r.p.m.) the A.S.I. was registering 185 km/hr (115 m.p.h.) and at full throttle (2,300 r.p.m.) I was clocking about 205 km/hr (127 r.p.m.). With this basic performance, the Minicab would seem to be ideal for racing purposes, especially as a 75 h.p. Minié installation is experimentally projected. For long-distance touring, the cabin is comfortable, although a little noisy. Ventilation is adequate, and in anything but real turbulence the ride should be relatively smooth.



Good landings are easy to accomplish, whether flap is used or not. Circuit speed is 150 km/hr and a safe, flapless, gliding approach at 125 km/hr is by no means unpleasantly shallow. With such light controls the tendency to "over-pull" on the flare-out must be checked, but the machine shows no tendency to balloon if the stick is moved back on touch-down at about 80 km/hr. Despite the lack of hydraulic or pneumatic shock absorbing, the undercarriage is remarkably resilient and, even taxying on rough grass, one's spine does not suffer unduly.

The full-flap setting is very effective and useful for getting into confined spaces. The safe approach speed in this condition is 110 km/hr and the elevator trim lever needs to be well back. Speed drops off quickly after touch-down and the braked landing run is only about 75 yd.

There can be no doubt that M. Gardan has managed to embody in the Minicab most of the ingredients which go to make an ideal light aircraft. It is exceptionally easy to fly, and eminently suitable for *ab initio* instruction. Having speed, range, comfort and control characteristics to satisfy the most exacting connoisseur, it is yet the cheapest light aircraft on sale in France. In its category, the Minicab is certainly an outstanding aircraft and a scheme for licensed manufacture outside France might be well worthwhile.

(This is the second of a special "In the Air" series, on contemporary French aircraft, by E. A. G. Rumbelow).

BÉARN MINICAB

Continental A-45: 45 h.p. at take-off, normal airscrew

Wing loading	10.6 lb/sq ft (52 kg/sq m)
Power loading	17 lb/h.p. (7.7 kg/c.v.)
Gross weight	1,100 lb (499 kg)
Disposable load	483 lb (219 kg)
Max. speed	124 m.p.h. (200 km/hr)
Cruising speed (econ.)	112 m.p.h. (180 km/hr)
Initial rate climb	680 ft/min (3.5 m/sec)
Service ceiling	13,120ft (4,000m)
Still-air range	466 miles (750 km)
Fuel consumption	2½ gall/hr (12 litres/hr)
Stalling speed (clean)	47 m.p.h. (75 km/hr)
Stalling speed (half-flap)	45 m.p.h. (72 km/hr)
Take-off run	460ft (140m)

As this photograph clearly shows, the cockpit is easy to enter, and, from the pilot's viewpoint, simple, neat and "vision-worthy" layout.

BLIND-FLYING BIRTHDAY

How, Twenty-one Years ago, C.F.S. Started Putting Pupils under the Hood

By PATRICK JOHNSON

ONE of the most important milestones in the history of Royal Air Force flying training was the introduction, just about 21 years ago, of instrument-flying instruction; almost overnight, it reversed the whole theme of flying "by feel." The officer made responsible for putting the new scheme into effect at the Central Flying School was one who is today managing director of Power Jets (Research and Development), Ltd.—F/L. W. E. P. Johnson, A.F.C., C.P.A., A.F.R.Ae.S., R.A.F.O. He tells the story here.

When the C.F.S. blind-flying courses were well established, F/L. Johnson equipped a Vickers Victoria as a "flying classroom" in which pupils had to fly by instruments whilst seated with their backs to the direction of travel.

IN 1929, Service flying-instruction technique was based on "flying by feel"—or, more vulgarly, by the seat of your pants. Lots of good pilots were taught that way, and lots more killed themselves trying to put precept into practice. The *ab initio* school curriculum, if memory serves me, included an hour or so of cloud flying; and when (or if) this was done, it was usually in about 5/10ths cumulus, so that one was actually in cloud (and straight and level) for a minute or two at a time.

Adventurous souls sometimes climbed through a layer, even unto three or four thousand feet thick, and, provided everything was nicely trimmed and set, they could get up or down pretty well. The wiser survivors were those who did not try this on northerly courses, while even east or west had a funny knack of resulting in a magnetic storm which caused the compass to spin (*never*, of course, the aircraft!). Oddly enough, as soon as turn indicators came in, magnetic storms ceased to occur—an interesting example of nature retreating before science.

At the C.F.S., then at Wittering, we used to take pupils from foreign air forces, and one day a delightful Frenchman, one Commandant Augereau, turned up. At that time "D" Flight (F/L. Harrison) took such pupils, and was called the Refresher Flight for two reasons, (a) because it gave refresher courses to those in need and (b) because it was responsible for considerable entertainment in the Mess. It was necessary to give Augereau the Instructors' Course in French. Bolder (or less self-conscious than the others) I was invited to inflict my version of that language on this unsuspecting officer, whose gallantry under that assault was nothing short of remarkable.

The author—a portrait of which, no doubt, he strongly disapproves; it was taken two years ago, when he was persuaded to take part in the film "Wonder Jet," which dealt with Sir Frank Whittle's development of the gas turbine. Seconded to Power Jets Ltd., in 1941, F/L. Johnson supervised the installation of the first unit in the Gloster E.28/39.

This gave me a wholly false reputation for being able to fly in French. Shortly afterwards the C.F.S. was told to detail an instructor to go to France on a civilian course in "pilotage without exterior visibility," at Farman's place, Toussus-le-Noble. I was given the job.

The Farman people were grand. Their School aircraft were incredible, but capable of being airborne and apparently utterly reliable. Those in use for our purpose were biplanes rigged to be unstable in pitch and roll, and were inherently unstable in yaw. They had water-cooled radial Anzanis. The pupil, after insinuation into the front cockpit, had a tin meat-dish cover bolted (from the outside) over him, which created a remarkable ventilation from the rear cockpit, whence came the smoke from the pilot's cigarette. There was a compass, a gyro turn-indicator which worked but had—in my opinion—a bad type of indication; a liquid fore-and-aft level; and an A.S.I.

I did about eight hours of it. The tuition was empirical; one was told to fly on such-and-such a course, to turn to another, and so on. It all worked—and, despite my description, remember that this was a pioneering effort, for which I give Farman full marks. I finished gloriously by flying a big twin-engined Farman bomber from an office inside the fuselage, and that got me a "brevet of competence," with which I came back to Wittering after three weeks of alternating terror and hilarity.

My Commandant at the time was Jack (now Sir John Baldwin), and he had vision. So had "Ginger" Mitchell—who was, I think, Air Member for Training. Group (No. 23, at Grantham) fell for my reports, and so we were told to find a good turn-indicator, make suggestions about hoods, and work out a training scheme. I was given an Avro to play with, and various guinea-pigs on the station were pressed into service to act either as look-out or as a test-piece under a hood.

Things now began to take on an earnest aspect. We were asked to recommend how to teach the whole Service how to fly blind, and I think I recall an edict which said that every pilot, including the whole of the new entry, had to be trained in two years; quite a job, since no Service or instructional aircraft had turn-indicators.

We selected, after prolonged test, the Reid and Sigrist gyro instrument. I believe the selection has justified itself—recall that this was twenty years ago. We laid down its "rates." We devised and built hoods, on the station, and equipped a new Flight ("E"), with a distinctive marking of C.F.S. colours, very necessary to keep other aircraft clear. We flew every Service type with a turn-indicator temporarily installed, to check its blind-flying qualities. We tested a large number of pilots to find out what the human problems were, and we found several things which were, at that time, rather revolutionary. We learned that you do not and cannot fly by feel, and that vision of an external datum was essential (a gyroscope is, in effect, such a datum). We discovered the standard sequence of events which caused people to spin in

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BLIND-FLYING BIRTHDAY . . .

An historic picture, by "Flight's" chief photographer, of F/L. Johnson taking off solo, and under the hood, in an Avro 504N at Wittering in 1931.

clouds. We found the average time for which a trained pilot could fly blind to be about eight minutes. We found that no pilot tested, save one, on any station in the U.K., whether or not he claimed to have done "hours of it, old boy, in 1917" could in fact fly an Avro blind and get away with it; and we tested many hundreds. We found that, whereas pupils were taught about northerly turning-error, and there was even a text-book reference to east and west acceleration error, not one pilot tested had any real idea of what happened, or could discriminate between (a) compass movement due to opening his throttle on E, and (b) a yaw from E to N—which, if falsely corrected for by rudder, accentuated the condition.

Above all, we took up the majority of pilots on home stations throughout the Service, and many visitors from overseas, plus a large number of commercial pilots, and we convinced them that they *couldn't* fly blind (whilst ourselves learning *why* they couldn't). I have often sat in my Avro for eight hours a day, taking up pilots at the rate of one every twenty minutes, and going through the set piece. Very dull, though at that time vitally important. After that season of tours, Air Force "fatals," according to such information as I was able to get, dropped from 80-odd in a year to 40-odd. Up to this phase, a prevalent form of crash had been that resulting from an aircraft spinning out of low cloud. These facts and figures seem to prove something, though life was so hectic at that time that I won't vouch for their accuracy.

The negative doctrine which we spread from C.F.S. was curious in two ways. First, it *was* negative; it taught only a "couldn't." Second, it was exactly contrary to C.F.S. and all other flying-instruction doctrine, in that whereas we had formerly taught people to fly by feel, we were now teaching them that to fly by feel was impossible.

I am sure that my seniors were very wise to allow my Flight's doctrine to be so seditious and heretical.

In the event, "E" Flight trained instrument-flying instructors, and a certain proportion of non-instructor personnel for special reasons, e.g., Gayford and Nicholetts before their England-Cape flight in the Fairey long-range monoplane. Instrument flying was then also incorporated in the ordinary flying instructors' course. Meanwhile, the schools and Cranwell were equipping with hoods and G.T.I.s, and long before the first year was out every *ab initio* was being trained in the art, squadrons were being heavily infiltrated and instrument flying was "in."

We worked a three-week course, one week being "break," and the "break" was used largely for touring stations, on a propaganda basis. At first we took only four pupils per course. On the second course, my log-book shows as a pupil one F/O. Selway, in November 1930. He got an "above average" assessment. Now, as A. Cdre. A. D. Selway, D.F.C., present Commandant of the C.F.S., he will doubtless forgive the confession that it must have been a little difficult for us to know what the "average" was, since he was within the first half-dozen pupils to take the course!

"Flight" photograph

In this enlargement from a group photographed at C.F.S. in July, 1931, *are (left to right), F/L. Johnson and two officers who have since attained exalted rank—F/L. (now Air Marshal Sir Basil) Embry and G/C. (now Air Marshal Sir John) Baldwin. The last-named was the Commandant at Wittering at the time.*

The C.F.S. Spirit

We were so delighted with the help and enthusiasm of our own pupils that I rather think they were all "above average." Seriously, though, the venture would not have worked at all if those early pupils had not so readily and quickly picked up the C.F.S. spirit, and joined in the experiment (for such it was) as keenly as if their performances, and not ours, were going to be judged by the Powers that Be. Those pupils had a lot to put up with. One of the tests was to work out a triangular course of about an hour, and fly it under the hood. Believe it or not, with an indifferently good compass and the turn-indicator alone, it was exceptional for a pupil not to finish within gliding distance of the airfield. That required real concentration, on a sloppy and directionally unstable aeroplane with a cruising speed of about 90 m.p.h.

Needless to say, we had our moments. There was a hard core of pilots who resented the implications of our doctrine. Many "lines" were destroyed and, of course, we shot our own. I had one lovely line about flying in cloud (on a day when everyone else should have been grounded) and feeling a heavy blow somewhere; on landing, I found a pair of perfectly clear tyre-marks on my top wing, corresponding precisely to the undercarriage of another Lynx Avro. . . .

One could play some odd tricks, too. My old friend Gilbert Batholomew, now deceased, was acting as look-out for me on a hooded practice from Wittering to Hendon, and at a certain point I said, as authoritatively as I could, "on your right you will see Bedford, about four miles abeam."

BLIND-FLYING BIRTHDAY . . .

He was pretty shaken; what happened was that I had smelt the brickworks smoke and knew the westerly wind did just that to the smell. Peterborough was another region you could always smell, down-wind at about 3,000 feet.

We had terrific arguments. There was, for example, an opinion that the liquid-level, on which I insisted for fore-and-aft control, was valueless. It was of course, not much good, because of accelerations. But one could and did fly on it. I had pivoted shutters worked by string from the front cockpit, to rob the pupil of certain instruments. A good pupil, without an A.S.I., could fly pretty well straight and level by liquid-level and altimeter. Since there was no such thing as a de-iced Pitot head, this was invaluable.

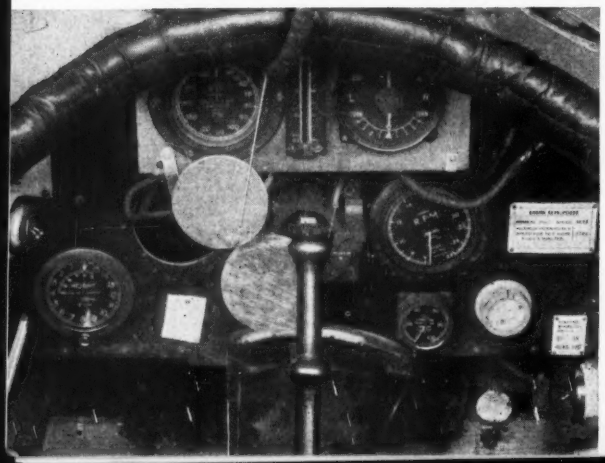
Talking of icing, I believe we had a more intensive experience of it than anyone else had at that time. I know my Flight (four aircraft) had 18 forced landings on one day. One reason was that we flew in almost any weather that wasn't too windy for a Lynx Avro. We had intake-icing literally by the bucketful, and much plug-sooting in consequence. The drill was to force-land in a field; get out, leaving the engine idling; and wait till a waterfall came out of the air intake. Then you were thawed, and took off again. It was great fun; at least, for the instructors.

Reverting to controversy again, we had the Great Flat Turn Argument. We found that, on every type we flew, if you did your turns so that the turn and the bank needles of the Reid and Sigrist were held at 180 deg (i.e., if you skidded a bit) the aircraft could be held dead steady with no difficulty. Since you were always well above stalling speed, there was no risk. If you banked properly, it was the devil of a job to keep a steady air speed and rate, so turning on to a given compass-course was very tricky. The pundits and purists loathed this. We argued it purely practically. Various renowned test pilots set themselves up to show how wrong we were. Of those I flew with, none could do a consistent course-changing turn really cleanly, whereas all our pupils could and did. I still maintain that we were right in our heresy—as a matter of expediency.

First Solo Blind Flight

One day I was flying rather late with Chris Lewis as pupil. I realized that the sky was clear of aircraft, so we landed out on the airfield and Chris got out. I got in the back, pulled down the hood, took off, climbed in an orbit, did a spin, recovered, glided 1,000 feet, opened the hood, and landed at the tarmac without using engine. It was, I believe, the first solo blind flight to be done. Without radio, it was (I still think) rather a risk, but it had very remarkable subsequent propaganda value, as it became a standard demonstration, and a very convincing one. It was, of course, often done by the pilots of "E" Flight, and when

"I had pivoted shutters worked by string from the front cockpit, to rob the pupil of certain instruments. A good pupil, without an A.S.I., could fly pretty well straight by liquid-level and altimeter."



Flight wrote of the C.F.S. on July 17th, 1931, their observer said:—

"The third course at Wittering is instrument flying, vulgarly called 'blind flying.' This is no mere 'stunt' as some people suppose. . . . During our visit to Wittering we were privileged to see a most remarkable feat. One of the instructors actually took off solo with the hood over his head. Our last photograph shows the Avro with its tail up a couple of seconds before the wheels left the ground. It can be seen that the front seat is empty, and we can vouch for it that there was no instructor crouching down in the cockpit. The pilot took off perfectly, climbed to a safe height, and actually put his machine into a spin. He came out of it, brought his Avro to an even keel, and flew level round part of the aerodrome before he put his hood back. It was an amazing perfomance, quite possibly the greatest feat of piloting we have ever been privileged to see. Yet the only special instrument was the Reid and Sigrist gyroscopic turn indicator. With that, and with his ordinary instruments, this instructor was as sure of himself as if he could see the horizon all the time. When skill at flying with instruments can be brought to this pitch fog begins to loose its terrors for the pilot. Such skill, however, is not yet universal. We believe, though we are open to correction, that nowhere else in the world can one see a pilot take off solo, spin, and recover with this hood over his head. This feat is unique, only to be seen at Wittering at the C.F.S."

This was entirely in keeping with the standing and reputation which C.F.S. had and, of course, still has.

Blind-landing Experiments

Meanwhile, other things were happening. Experiments were going on at R.A.E. with a "ground proximeter," to enable aircraft to land in fog after approaching on a course set by a captive balloon notionally above the fog. A considerable vogue was growing up for special instruments, and we tested some pretty extraordinary devices. Up to the time I stopped, in 1932, the artificial horizon was not in, though it was obviously on its way. A serious limitation was lack of radio. One interesting phase was the "flying classroom" of "E" Flight—a Vickers Victoria with non-transparent windows and two sets of controls and instruments back in the cabin. In this I occasionally took up about twelve pupils, each of whom had a turn first facing forwards and then facing aft. In the latter position not only was "feel" no good but it was actually reversed—rather like riding a bike with hands crossed on the handlebars. One simply *had* to fly by instrument. The Victoria was not, on the whole, a great success, though I still think it could have been made into something useful. [See heading picture, page 646—Ed.]

I converted an old fuselage into a sort of very elementary ground-trainer, in the possibilities of which I was a firm believer. This had a set of instruments (turn-and-bank and A.S.I.) worked off the pupil's and instructor's controls differentially, so that the instructor could apply a movement, and the pupil could restore it; a good gadget for its day, but I was too preoccupied with real flying to do much about developing it.

Until "E" Flight was formed Basil Embry (now Air Marshal Sir Basil Embry) was my Flight Commander and, as many in the R.A.F. know to-day, he is an incredibly inspiring officer to work under. It was in large measure by his tacit encouragement, and by virtue of his loyalty to his subordinate, that many highly irregular but nevertheless progressive things were done which would otherwise not have been done. Instrument flying owes much, also, to the then Chief Flying Instructors of C.F.S. (one of whom is now Air Marshal Sir James Robb); to the successive Commandants; and to the most loyal and efficient bunch of instructors, N.C.O.s and men ever gathered together in one Flight. All of which is merely to underline that there isn't any unit other than the C.F.S. where the whole pattern of flying training—and therefore of flying technique—could be quickly and painlessly changed for the better in the course of a year or two.

[The foregoing article was originally written for a forthcoming number of "C.F.S. Magazine"; the C.O., A. Cdre. Selway, has generously consented to its appearing here in advance.—Ed.]

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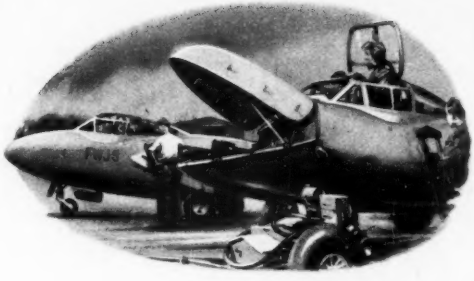
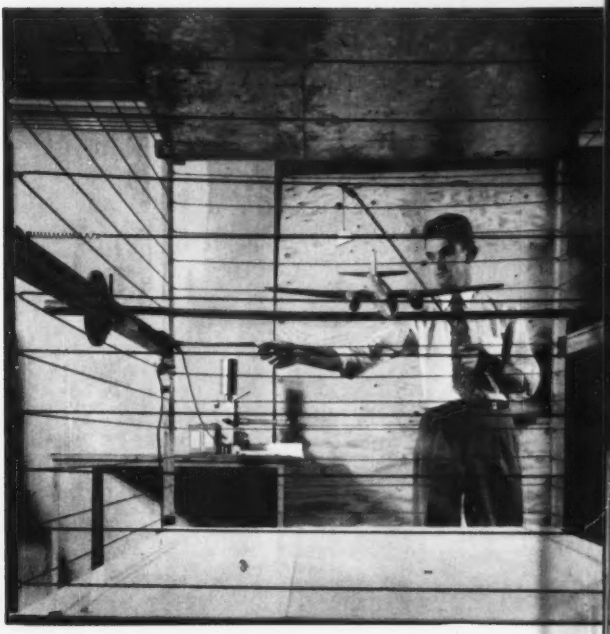




U.S. RADIO AND RADAR RESEARCH

ILLUSTRATED on this page are some aspects of current American research and development in, first, aircraft radio and, second, early-warning radar.

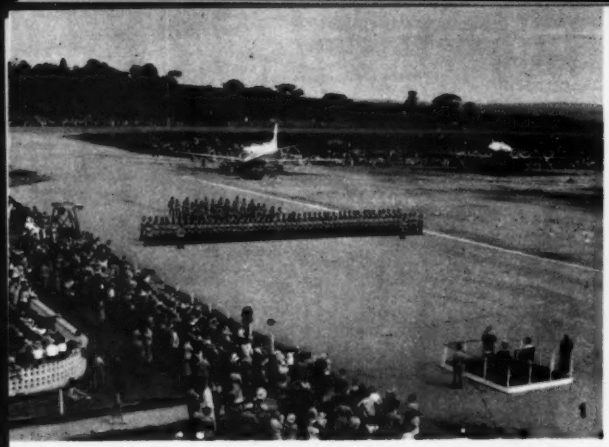
The radio experiments are being made by the Aircraft Radiation Systems Laboratory of the Stanford Research Institute in California, under the sponsorship of the U.S.A.F. Research Laboratories at Cambridge, Mass. Work now in progress is concerned with, *inter alia*, developing more efficient methods of utilizing parts of the aircraft structure itself as an aerial for low and medium frequencies; finding a narrow-beam microwave-aerial structure suited to "suppressed" mounting within the airframe; establishing the use of electrostatic methods and optical analogies in antenna research; and advancing investigation in the general study of airborne communications and navigation requirements in order to establish practical criteria for the evaluation of various aerial configurations.

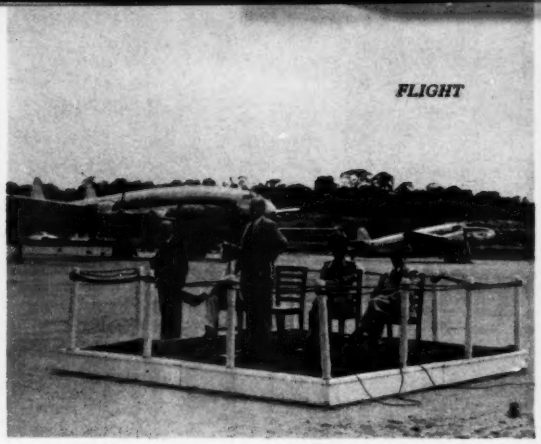
Some of the equipment now in use in this work is shown in the photographs. On behalf of the Communication and Navigation Laboratory of the U.S. Air Materiel Command at Wright Field, Ohio, the Laboratory has also completed the development of a multiplexing system for aircraft communications and navigation equipment. This system, it is reported, provides for simultaneous operation, on an integrated aerial system, of all the major aids in current use.

The radar picture is from the American General Electric Company, who disclosed recently that they have completed a U.S.A.F. order for "the largest and most complex radar systems ever produced." Early-warning equipment of the type shown is being installed at posts (number and location not revealed) in the "radar fence" now protecting the U.S. and Canada. Some 400 personnel are needed to man, on a 24-hour basis, the multiple operational positions at each installation. A single system can intercept a large number of raids simultaneously.

Installations in Arctic regions are to be protected from the weather by rubberized-fabric radomes of the type shown, supported entirely by air pressure. An aluminium framework is used to raise the dome, which is 54ft in diameter and 36ft high, and is retracted into the floor, so as not to cause signal interference, after it has been inflated by a low-pressure air supply. It is stated that under an internal pressure of only 0.5 lb/sq in. the dome will withstand winds of up to 125 m.p.h. Infra-red lamps trained on the walls keep them free of ice and snow.

Above, left, is part of the Stanford Research Institute's outdoor equipment for aircraft-aerial research. The lower tower-mounted model can be rotated about vertical and horizontal axes whilst the signals which its aerials receive from a distant transmitter are measured. Above, right, a model is seen in an electrostatic cage whereby low-frequency-radio fields are simulated. The lower picture shows the big protective-fabric dome of the G.E.C. early-warning radar being raised to the operating position.





AT AFRICA'S AER

Scenes at the Official Opening of Entebbe,

LAST week we briefly reported the ceremonial opening of Entebbe Airport, Uganda, upon completion of its five-year, £350,000 reconstruction scheme. We are now able to give these pictorial impressions, together with further notes on the ceremony, supplied by the Editor, who was present.

The event was favoured by the weather: for several days unexpected and seasonally late rain had been falling, but on the important day (November 10th) conditions were warm and pleasant, with clear skies revealed above great storm-clouds piled in the north and west.

In his speech declaring the airport open, Mr. H. S. Potter, C.M.G., Acting Governor of the protectorate, recalled the early associations of the site, which was first used as an airfield in November, 1928, when Capt. R. R. Bentley landed there [in a Cirrus Moth] with the then Governor, Sir William Gowers, whom he had flown over from Jinja. In the same year Sir Alan Cobham put down his flying-boat [the Short Singapore used on the famous African survey flight] on the adjacent Lake Victoria, and in 1929 the 800 yd by 50 yd strip was in a fit condition to receive the aircraft of the R.A.F. Cairo-Cape flight.

The second phase of development, continued Mr. Potter, came with the development of commercial flying, when Entebbe began to be used by Imperial Airways in January 1932 for their Cape-to-Cairo mail services; at this time radio was installed. By 1935 a murram surface had replaced the runway grass, and some rather primitive passenger accommodation had been provided. Considerable extensions were planned, but for various reasons little was done until after the war. In 1944-45 the main runway was bitumenized and extended to 1,600 yd.

In planning the ultimate phase of development they had been fortunate in receiving a visit from Sir Frank Whittle, who gave advice on the requirements of jet aircraft; his suggestions had been incorporated in the plans.

Mr. Potter then enumerated the principal features of the scheme, now completed—the extension of No. 2 runway to 3,300 yd, with a bitumen surface 200ft wide and margins bringing the total width to 700ft; improved night landing and take-off

"Flight" photograph

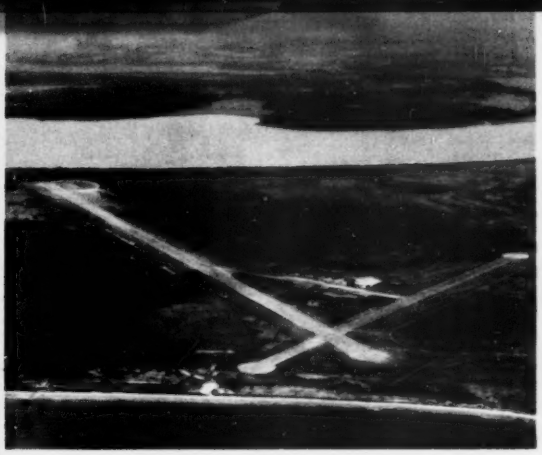
(1) *The smart Uganda Police guard of honour at the opening ceremony. In the background are the B.E.A. Viscount and B.O.A.C. Hermes.*

(2) *The Crewsair Viking, in which a party of visitors flew from England to attend the ceremony.*

(3) *The central frontage of the terminal building, gay with flags and crowded balconies.*

(4) *Coolness, comfort and perfect taste in interior decoration—the airport lounge and bar.*

(5) *The Acting Governor, Mr. H. S. Potter, makes his speech declaring the airport open. The seated officer is A. Cdre L. T. Pankhurst, A.O.C. East Africa; next to him is Sir Reginald Robbins, Commissioner of Transport; A.V-M. Sir Victor Tait, B.O.A.C.'s Operations Director, is behind the speaker.*



"Flight" photograph

IAL CROSS-ROADS

Uganda's Extended Land-and-water Airport

facilities; a new control tower; and passenger amenities providing speed of transit and real comfort (shower baths, for instance, are provided to allow transit passengers to refresh themselves). In the first ten months of this year, added Mr. Potter, 1,378 aircraft, carrying 15,000 passengers, had been handled.

After speaking of various places of interest in the locality, of Uganda's mineral and other resources, and paying tribute to those who had played a part in the construction scheme, the Acting Governor formally declared the airport open.

As he spoke, the Union Jack was broken at the control-tower mast, followed by the Civil Air Ensign as the B.E.A. Viscount taxied out, and then by the R.A.F. Ensign as three R.A.F. Vampires prepared to give their display. After a steep take-off and climb the Viscount gave a very brief demonstration and then departed. The Vampires were three of the four which, as reported elsewhere, were engaged on proving jet-reinforcement routes from South Africa to the Canal Zone. Well-worn operational aircraft handled by pilots not specially trained in display work, the three machines nevertheless put up an excellent show of formation and individual aerobatics.

When the Vampires had landed, the American pilot of an Ethiopian Airlines Convair 240 demonstrated the Jato equipment intended for use at Ethiopia's high-altitude airfields; one of two Jato rockets "buried" in the centre-section was used, but there did not appear to be any very noticeable contrast to a previous unassisted take-off. An East African Airways' Lodestar—attractively refurnished in the company's own workshops at Nairobi—was then put through its paces in a lively manner.

Other aircraft present included a B.O.A.C. Hermes IV, a Viking owned by Crewsair, Ltd., A. Cdre. Pankhurst's Valetta, and a Tudor owned by Wm. Dempster, Ltd. (the last-named machine had a gently-fanning starboard outer airscrew, the reduction gear having stripped). A Dove, Rapides, Ansons and other aircraft from Nairobi, a smart new green-and-white Bonanza and a Piper Pacer—all these helped to make an impressive line-up.

Among the 40,000-odd visitors was King Kabaka, a young African ruler who completed his education at Cambridge.

"Flight" photograph

(6) *No. 2 runway, extended to 3,300 yd in length, is now Africa's longest. The taxi-track loop at the north-west end has been added to accommodate aircraft waiting to give priority to jet arrivals.*

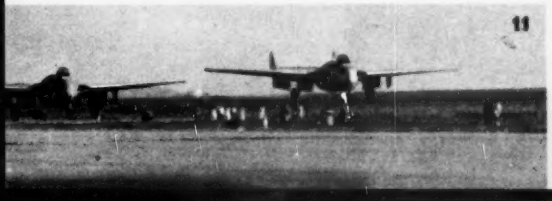
(7) *The Vampire pilots stand by near the terminal building.*

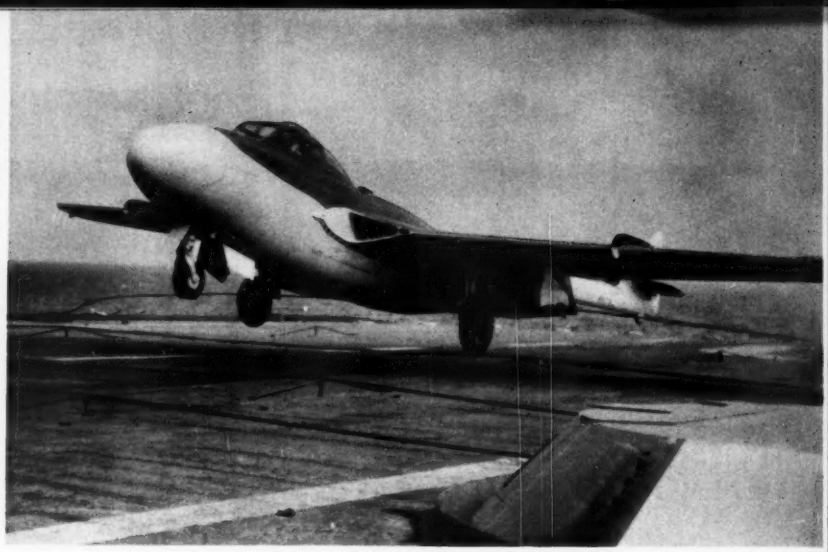
(8) *A Convair 240 of Ethiopian Airlines demonstrates Jato equipment.*

(9) *Thousands of gaily dressed natives swarmed in from the surrounding countryside. Here is a small section of the crowd of 40,000 spectators, with an Air France Constellation in the background.*

(10) *Local architecture at its most attractive—Lake Victoria Hotel, Entebbe.*

(11) *The R.A.F. Vampires come in after their aerobatic show. The flight was engaged on a survey of the Cape-to-Suez route for jet-aircraft reinforcement.*





A close-up action study of the Sea Venom prototype an instant after the arrester hook has engaged a wire. Note the "fences" on the wing.

SEA VENOM TRIALS

The de Havilland Carrier-borne, Two-seater, Radar-equipped, Night-and-all-weather Fighter is Tested Aboard H.M.S. "Illustrious"

THE accompanying pictures of the prototype de Havilland Sea Venom N.F.20 undergoing deck-landing trials aboard H.M.S. *Illustrious* in the English Channel during July (the photographs have only recently been released) will remind readers that it was a Sea Vampire which, on December 3rd, 1945, became the first jet aircraft to land aboard an aircraft carrier.

The Sea Venom has been adopted as standard equipment not only by the Royal Navy, but by the Royal Australian Navy and the French Navy, and represents a very real advance over the Sea Vampire in all aspects of performance. Its first carrier take-off was on the bright morning of July 9th with Lt. Cdr. D. Callingham, D.S.C., R.N., as pilot. Within three days, 60 take-offs and landings had been made by Lt. Cdr. Callingham and Lts. Price and Robertson. The greatest number of take-offs—34—was recorded on the second day, July 10th.

Throughout the trial period there was no incident of any kind, and the aircraft frequently became airborne after running for only two-thirds of the flight deck. All pilots remarked on the excellent view of the flight deck and the batsman obtainable during the approach.

On the fourth day a demonstration was laid on for C.-in-C., Coastal Command, before the aircraft returned to Boscombe Down for further tests.

The Sea Venom N.F.20, which is armed with four 20 mm guns, is the fourth jet-propelled fighter adopted for service with Naval Aviation. First was the Sea Vampire, to which reference is made above; then followed the Vickers-Supermarine Attacker, the first squadron of which has recently formed; and third, the Hawker Sea Hawk, now well advanced in production. All three of these types are single-seaters, and may be considered as successors to the piston-engined Sea Fury, whereas the two-seater Sea Venom will displace the night fighter version of the de Havilland Sea Hornet.

An approach shot, showing to advantage the extended arrester hook, the large-area flaps and the wide-track, nose-wheel undercarriage.

Apparently "going round again," the new night-and-all-weather fighter takes full advantage of the accelerating qualities of the Ghost turbojet.

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RAFTS AND DINGHIES

Modern Air/Sea Rescue Techniques and Equipment Reviewed in a Lecture

UNUSUAL in its subject and informative in its presentation, a paper on air/sea rescue equipment was recently delivered to members of the Society of Licensed Aeronautical Engineers by Mr. D. K. Hailstone of the R.F.D. Co., Ltd. The lecture was given at the Hamble H.Q. of Air Service Training, Ltd., where a swimming-pool enabled the speaker to give practical demonstrations of several items of the equipment he described. A digest of the lecture follows.

Mr. Hailstone began by saying that he proposed to consider air/sea rescue and survival as part of the overall rescue system. Air rescue in its widest sense was, of course, universal, ranging over Arctic, desert, jungle, mountains and sea in search of those in distress, whatever the cause. It must be realized that even the great airlifts of recent years had been in the nature of rescue services to succour those cut off from other means of transport. In the last war, British air/sea rescue units in Europe, the Middle East and Indian theatres saved 14,700 persons; the A.S.R. organization in the United Kingdom saved roughly one-third of all those who fell into the sea.

After the war, several committees were set up to analyse the experience of the past. At the beginning of the war resources had been very limited. Dinghies available had been of the circular types, such as the "H," and "K" one-man models copied from the German single-seat raft. Out-dated dinghies of these types were still in use today, their design having been changed very little. The rescue organization was not formed until February, 1941—already two years too late. Development of rubber-proofed fabric life-rafts was begun by R. F. Dagnall, founder of the R.F.D. Co., in 1917, and his circular flotation gear ultimately developed into the circular rafts used at the outbreak of war. In 1937 the R.A.F. adopted automatic CO_2 cartridge actuating gear, again developed by R.F.D. In 1927 Hubert Scott-Paine had started the design and construction of hard-chine air/sea rescue launches, and we had other good aids in the flying-boat, amphibious aircraft, and parachutes. These four items, dinghies, launches, aircraft and parachutes, formed the hard core round which the A.S.R. services were formed and developed. The following figures would give an indication of the results achieved in 1941: R.A.F. Walrus amphibians saved 13 lives, R.A.F. high-speed launches saved 147, R.A.F. seaplane tenders 8, R.N. rescue launches 194, and R.N. seaplane-tender safety boats 10. The R.N.L.I., called out by A.S.R.S., saved 34 lives.

Some of those survivors who reached the water and inflated their rafts were never found and many who were found were dead due to the effects of exposure, shock and wounds. A considerable portion of these could have been saved if we had had present-day equipment available.

Airline Applications

After the war it was left to I.C.A.O. (then known as P.I.C.A.O.) to see that the survival lessons should be applied as far as commercially possible to civil aviation, and they drew up an ambitious scheme, the outcome of the final reports of the Search and Rescue Committee. To implement this scheme it was arranged that all countries taking part should contribute something towards search and rescue facilities. The larger countries, with extensive coast-lines, were to provide very-long-range aircraft; long-range, medium-range and short-range aircraft; rescue boats for limited search; rescue vessels for ocean work; land rescue units; parachute rescue units; and, of course, rescue co-ordination centres were to be established. Smaller countries were to provide services in proportion to their means. This organization was to replace the military organizations which had been very much curtailed at the end of the war.

During the last 125 years, continued the lecturer, the Royal National Lifeboat Institution saved 76,000 lives, in spite of all that had been done to make sea travel safe. It was, therefore, as well to assume that there would be casualties in the air even in peace-time and adequate arrangements must be made to deal with them. Discussing first the design of aircraft themselves, Mr. Hailstone said that from the safety angle, the designer must provide adequate escape hatches and stowages in the wings or fuselage for dinghies, and he must also provide against fire. Seats had to be considered in the matter of providing against deceleration, and lifejacket stowages provided. The ditching characteristics of the aircraft were also to be taken into consideration.

As regards deceleration, the human frame could survive very high deceleration provided it was adequately braced and supported. During the war aircraft crews, when ditching, were told to place themselves with their backs against bulkheads, and face the rear of the aircraft. It would appear that this was the best way to survive a crash, and it was high time that our civil airlines adopted rearward-facing seats as already in service in Transport Command.

Escape from an aircraft after ditching might be undertaken either before or after the crash. The parachute and ejector seat were provided for military personnel, but civil aircraft must still rely on escape hatches for use after the impact, and these should be large and adequate in number. It must be borne in mind that it was not always convenient to open the door of a ditched aircraft, since this might result in immediate flooding and sinking.

Many factors influenced the severity of the ditching, such as the skill of the pilot; the state of the sea, and wind; the condition of the aircraft before impact; and its shape and strength. A low- or mid-wing large aircraft was a better ditcher than a high-wing type; a sharply upswept nose was a disadvantage; a fighter with a low thin wing could be expected to dive violently on impact; large aircraft were inclined to break forward and aft of the wing. The wing provided a great deal of buoyancy, particularly when fuel had been used up. After ditching, the airframe was bound to be extensively damaged and water nearly always entered rapidly, the inrush breaking down bulkheads, etc., and further weakening the structure. It was, therefore, important to provide as many escape-hatches as possible. Valise-stowed equipment tended to get left behind and it was, therefore, important that blow-out stowages should be built into the fuselage or wings.

Life-jacket Design

Turning to equipment for personnel, Mr. Hailstone said that the first necessity was the life-jacket. In military aircraft these are always worn by the crew, but in passenger types the normal stowage was under the seat. The operating requirement for both types was that the wearer should be kept in the best attitude for survival, whether conscious or unconscious. Further aids were provided by a light, to enable survivors to be located in darkness and to keep together easily, and a whistle to attract attention. A requirement of the civil jacket was that it should be easily put on by untrained personnel; this, thought the lecturer, had been achieved very well in the R.F.D. Type 50 C Mk. II jacket.

For Service personnel, other factors have to be taken into consideration, such as parachute harness, pressure waistcoats, helicopter lift, attachment to dinghies and fluoroscine-dye markers. These requirements had been met by the Type 51 AF Mk. I.

Re-emphasizing that many personnel have been lost through lack of exposure protection, Mr. Hailstone went on to speak of the R.F.D. Universal life-rafts [the subject of a description in *Flight* of October 5th] which have an automatically inflatable canopy, so that the occupants are protected from the elements the moment they board the raft, and an inflatable floor which insulates them from the chilling effects of the sea.

In the Arctic, said the lecturer, closing all the canopy flaps would reduce loss of body warmth, while in the tropics protection from sun-glare prevented loss of moisture in the body and the consequent demand for water.

An occupant of a military aircraft who made a parachute descent had his dinghy attached to him, usually in a seat-type pack. This had, in the past, been the "K" type, and in the newer forms of ejection seat an exposure suit has been packed with the dinghy. Since this exposure suit has been almost impossible to don, said Mr. Hailstone, R.F.D. had built exposure-protection into their latest raft, which had an inflatable floor and an inflatable hood and apron, thus ensuring that the occupant has a barrier of still air between himself and the elements.

All aircraft, continued the lecturer, should be equipped with a dinghy radio transmitter ("Gibson Girl") and an emergency pack for each dinghy, containing such items as communications equipment (signalling torch, pyretechnics, heliograph and radar oscillator); water, or means of making sea-water drinkable; and rations, first-aid outfits, and other small ancillary items.

After listing the basic life-raft equipment (paddles, drogue, rescue line, etc.), Mr. Hailstone mentioned some aspects of procedure once a raft was boarded. If there was more than one raft, all should, as far as possible, be secured together, and arrangements made for transmitting with the portable transmitter. The aerial could be flown either with a hydrogen balloon or with a kite, depending on the force of the wind. The radar oscillator, if carried in the emergency pack, should also be started. A watch should be set, and visual signalling equipment kept ready to hand.

The emergency pack would contain a limited number of tins

RAFTS AND DINGHIES . . .

of water, to be used for immediate needs. Also provided in the kit should be the desalting units for rendering sea-water drinkable; sun stills, chemical stills or heat stills might also be provided, and should be set going as soon as possible. The raft canopy was provided with rainwater catchments which, on the ten-man raft, would provide over a gallon of drinking water per hour in moderate rain. Rations were mainly of psychological effect; men would die from lack of water long before they suffered any undue harm from lack of food.

Speaking of rescue gear designed for dropping from search aircraft, the lecturer described the war-time Lindholme apparatus, consisting of a dinghy in a millboard container, and four ration packs; these were attached one to the other and dropped to survivors in the water. The procedure was as follows: First a smoke flare was dropped to ascertain wind-direction, after which a dummy run would be made across wind and downwind of a dinghy in distress, or upwind of personnel floating with lifejackets in the water; then the "bombing run" would be made and the equipment spread out over a line of approximately 500 yards. When the gear reached the water the soluble plug in the operating head of the dinghy container would dissolve, the spring-loaded lever would operate the head, and the dinghy would burst its way out of the container, at the same time throwing out a drogue to prevent drifting. Likewise, drogues prevented the drift of the supply containers. By hauling in their own drogue, survivors in rafts would drift downwind on to the line of the Lindholme gear or, alternatively, if they were floating in lifejackets, the equipment would drift down on to them more rapidly than they themselves would move.

R.F.D. had evolved a modified form of this equipment and in the dinghy container had packed a Universal life-raft; the room saved in the supply containers by the fact that it is no longer necessary to include exposure suits had been utilised to provide more of the vital drinking-water.

Discussing future trends, Mr. Hailstone said that the new high-speed aircraft with their thin wing sections and pressurized fuselages were making the stowage of rescue equipment more and more difficult. No designer wished to cut large holes in his aircraft structure to stow safety equipment, so rafts and emergency equipment of less bulk and weight had had to be designed to meet the new requirements of the new military jet aircraft. The lecturer concluded by enumerating some of the methods by which this weight saving was being achieved, and then went on to give the practical demonstrations referred to earlier.

BACKGROUND TO THE S.A./4

WHEN the Short S.A./4 bomber (four Avons) was first revealed to the public gaze at Farnborough last September it caused more controversy than we remembered hearing for a very long time. Opinions on its appearance varied from an approving "grimly functional" to others which we forbear to quote. Most of the speculation centred on the fact that the general configuration followed earlier conventional lines rather than being characteristic of the "jet era," with sweepback, buried engines and so forth.

It must be borne in mind that only that week had the aircraft been permitted to creep from under its security curtain (and not to creep very far, even then), so that only the elect few knew very much about its whys and wherefores. Even now, little in the way of concrete facts can be quoted, and we therefore welcome the following background story of the S.A./4's development and *raison d'être*, released last week by its makers.

It is a matter for some pride (state Short Bros.) that, though there are embodied in the design of this machine several new features of which the company has previously had only limited experience, it has been remarkably free from the troubles that so often beset prototypes. At this juncture it is appropriate that the S.A./4 should be considered in its true relationship to the policy of the Ministry of Supply over the last five or six years. To do this we must examine the situation which existed at the end of the war when pure-jet engines, swept-back wings, the possibilities of high-altitude flight and supersonic speed were comparatively unknown quantities in their eventual bearing on future designs. Firstly, it was the policy of the Air Ministry to call for certain specifications to cover the rapid development in the technical field which was apparent at the cessation of hostilities. As part of this policy Shorts were asked to build an aircraft which, while possessing relatively high performance characteristics as a bomber, would not be unduly unorthodox in its general layout.

In point of fact the more advanced design built by Messrs. Vickers-Armstrongs Ltd., has proved successful and this, though highly satisfactory from the point of view that Great Britain should lead the world in development of aeronautics, has clearly reacted a little unfavourably on this company, whose task has been to construct, in the overall bomber programme, the more conventional and less modern design. On the other hand, these facts do not mean that the S.A./4 is obsolescent. Far from this being the case, there has been produced an aircraft capable of carrying the large loads demanded by modern operational requirements and which, it is confidently expected, will attain the performance specified by the Air Staff.

The remarkable absence of any major troubles in trials so far is mainly attributable to the great amount of research work carried out during production. In addition, the external finish has benefited greatly from such treatment as our own hot dimpling process, rivet head milling and other innovations initiated by the Development and Research Departments in the last two years, and in the case of the S.A./4 the external finish can be described as second to none.

Despite the fact that the power plants themselves are heavier than was estimated in the project stage, this weight increase has, due to the particular design of the aircraft, had far less effect on performance than would normally have been anticipated. The manner of engine mounting, in addition to greatly facilitating maintenance, has resulted in an aircraft that is eminently suitable for the speedy installation of later and more up-to-date power plant versions. The design of the nacelles is also a most important feature, for this type of mounting gives a satisfactory gain in thrust by reason of its unobstructed air intakes, a factor to the influence of which jet engines are particularly sensitive.

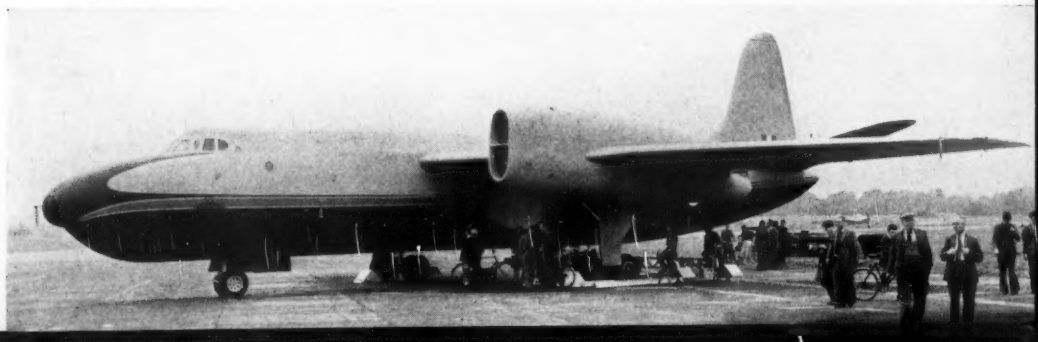
The S.A./4 has been designed to accommodate the Air Staff bomber requirements in the matter of radar, radio and similar installations and also embodies very advanced ideas in anti-icing present in very few aircraft today.

To sum up, Shorts have designed an aircraft capable of being used for extensive research, and the Ministry of Supply now have at their disposal a first-class modern aircraft on which to make new installations and experiments with new weapons and equipment. The continued use of almost obsolete types of aircraft for this extremely important work clearly shows the urgent need for modern research-aircraft available without disturbing production.

Even at this early stage the S.A./4 has shown that it is eminently suited to undertake its future duties. Its eventual contribution to the country's continued prestige in the quality and performance of its aircraft, though as yet impossible to gauge, may well prove to be the greatest of all. Furthermore, it has provided its designers with knowledge of immense value for future designs.

Of these designs it is not permissible to state anything at this stage beyond the fact that, armed with first-hand data concerning the construction of large, high performance jet-powered aircraft, the design personnel of the company are in a position to step into the very forefront of modern design.

". . . Shorts have designed an aircraft capable of being used for extensive research . . . and for experiments with new weapons and equipment."



CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Fighters on Tow

From Sir Alan J. Cobham, K.B.E., A.F.C., Hon. F.R.Ae.S. (chairman and managing director, Flight Refuelling, Ltd.)

FURTHER to the recent correspondence in *Flight* on the war-time experiments in towing fighters, Flight Refuelling, Ltd., carried out this work with a view to getting machines to Malta; the difficulty was that insufficient time was made available to develop the scheme. However, the chief problem was one of towing Spitfires on a single cable from the fuselage, as done in America. Owing to the closeness of the airscrew to the leading edge of the mainplane the scheme would have meant that the towing cable would have had to be at an angle of 45 degrees; whereas, with American aircraft with the nose well out in front, a much easier angle could be obtained, and one that was easily controllable on the rudder of the towed aircraft.

In consequence of these difficulties we had to develop a bifurcated tow, which proved to be quite successful. Another great difficulty was brought about because the machines that were available for Malta could not feather their props and in consequence the engines ticked over at slow revs while being towed, and oiled up. The machines were joined together on the ground with a system of suitable catches, and took off in parallel. The fighter was not towed off the ground, but took off under its own power, formating on the Wellington and then falling back until the cable took it in tow. The bifurcated-trace harness came up on either side of the prop without difficulty.

It is a great pity we did not have the drogue-and-probe system at that time.

Tarrant Rushton, Dorset. ALAN J. COBHAM.

Modern Montgolfier

I WOULD refer to the article "Modern Montgolfier" in your issue of November 2nd.

To show the lift claimed for the postulated 500,000 cu ft airship the hot air appears to have got into the "sound theoretical investigation" (*vide* your introduction to the article) rather than into the envelope.

Lift by displacement is limited to the weight of the displaced atmosphere, which for 500,000 cu ft is about 38,000 lb at sea level and 9,000 lb at 41,000 ft.

London, W.C.2. J. G. M. PARDOE.

WE have studied Capt. Arthur's article on the jet-heated hot-air dirigible weapon project and feel that the author has overlooked a fundamental point in his calculations.

(1) Assume that 1,000 cu ft of air at N.T.P. is drawn into a flexible bag contained inside the metal shell of the weapon. This volume is then heated to 1,000 degrees C, producing a new volume of 4,400 cu ft at 29.92 in Hg and "mentally":—

(2) If the valve on the shell is then closed and an external pump reduces the air inside the shell but outside the bag, to a pressure of 5.04 in Hg, corresponding to the correct atmospheric pressure of 42,000 ft approximately. The bag volume has now increased to:—

$$4{,}400 \times \left\{\frac{29.92}{5.04}\right\} = 26{,}100 \text{ cu ft}$$

The shell, complete with bag, has now been reduced to the conditions described by the author for 42,000 ft, this being the "correct" height for the ratio of 0.227 he quotes.

(3) Now, at 42,000 ft the air density value is 0.017 lb/cu/ft by I.C.A.N. standards, hence the lift at the 42,000 ft altitude for the original 1,000 cu ft of air at ground level is:—

$$0.017\ (26{,}100) - 76 = 368 \text{ lb.}$$

It should be noted that the ground-level lift-value is correctly quoted in the article as:—

$$0.076\ (4{,}400) - 76 = 258 \text{ lb.}$$

(4) Hence, for the given shell capacity of 500,000 cu ft quoted, the maximum possible lift of the weapon at 42,000 ft is:—

$$\left\{\frac{500{,}000}{26{,}100}\right\} \times 368 = 7{,}060 \text{ lb}$$

as compared to the quoted value of 230,000 lb in the article. The corresponding lift at ground level is 4,950 lb.

(5) The actual volume of air which can be drawn into the bag at ground level is:—

$$\left\{\frac{500{,}000}{26{,}100}\right\} \times 1{,}000 = 19{,}200 \text{ cu ft.}$$

This is the maximum volume which can be expanded to fill the given shell at 42,000 ft for a temperature of 1,000 degrees C. *Check:*—

$$19{,}200 \times 4.4 \times \left\{\frac{29.92}{5.04}\right\} = 500{,}000 \text{ cu ft.}$$

Further comments in respect of the rest of the argument are unnecessary.

Wolverhampton. STRESSER.

(We understand that the author of the article has an answer to these criticisms; we hope to publish it in due course.—ED.)

The Stout Films

YOUR representative (p. 585, November 9th) should not fall into the error of assuming that because of "desultory hand-claps at the end" of the R.Ae.S. screening of the Stout films the audience was unappreciative. They *were* appreciative, and if Ernest Stout had been present they would have demonstrated that fact. I have found that it is not the custom of British audiences to applaud films, so absence of clapping does not mean lack of appreciation.

London, S.W.11. JOHN BELL.

Dollar-Earning Comets

AS long ago as December 22nd, 1949, you were kind enough to publish a letter of mine in which I outlined a suggestion for placing the Comet on the New York/Bermuda schedules of B.O.A.C.

It was, therefore, a source of personal satisfaction when I read the news recently that B.O.A.C.'s chairman had officially announced that it had been decided to put Comets on this most lucrative dollar-earning route, and that our superb jet airliners would, in fact, become "dollar showcases" in about 12 months' time.

I'll just conclude by saying, "Jolly good show" to both B.O.A.C. and de Havilland's for officially announcing that they fully intend to "show the flag" to the U.S.A. with our great lead in turbojet transports.

Prestwick, Ayrshire. D.M.P.

Shaibah Slide

AS a regular reader I was somewhat surprised to see, in your issue of September 28th, p. 419, a small map of the Arabian area with the location of Shaibah badly misplaced. I let it slide; but now, in the November 9th issue, I am confronted with the same map and the same misplacement. Please let me know whether (a) the R.A.F. have moved that god-forsaken station further into nowhere, or (b) the artist has apologised.

Lincoln. R. E. SMALLEY.
Ex-Nav., 78 Sqn.

[(a) They have not; (b) He has.—ED.]

FORTHCOMING EVENTS

Nov.	23.	Helicopter Association: "The Giant Helicopter," by O. L. L. Fitzwilliams, B.A.
Nov.	24.	Society of Licensed Aircraft Engineers: Main Lecture: "Functioning of a Manufacturer's Servicing School," by D. W. Richardson, M.B.E., A.F.R.Ae.S.
Nov.	24.	Royal Air Force College, Cranwell: Rugby and Squash v. R.N.C. Greenwich (away); Soccer and Rifle Shooting v. R.M.A. Sandhurst (away); Old Cranwellians Dinner (London).
Nov.	27.	R.Ae.S. Section Lecture: "Aircraft Simplification v. Efficiency," by W. S. Farren, C.B., M.B.E., M.A., F.R.S., M.I.Mech.E., F.R.Ae.S.
Nov.	27.	Society of Instrument Technology: "Visual Presentation," by K. F. H. Murrell, M.A., F.R.P.S.
Nov.	29.	R.Ae.S.: "Structural Problems in Advanced Aircraft," by H. H. Gardner, B.Sc., F.R.Ae.S.
Nov.	29.	Northern Heights Model Flying Club: Annual Dinner and Dance.
Dec.	1.	Royal Air Force College, Cranwell: Boxing v. R.M.A. Sandhurst (home).
Dec.	1.	Pathfinder Club Annual Ball, Dorchester Hotel, London.
Dec.	5.	Royal Air Force College, Cranwell: Rugby and Squash v. R.M.A. Sandhurst (home).
Dec.	5.	Royal United Service Institution: "The War in Korea, with Special Reference to the Difficulties of Using our Air Power," by W/C P. G. Wykeham-Barnes, D.S.O., O.B.E., D.F.C., A.F.C.
Dec.	6.	R.Ae.S.: "Air Intakes for Gas Turbines," by J. Seddon, A.F.R.Ae.S.
Dec.	7.	Herts and Essex Aero Club: Annual Dinner and Dance.
Dec.	7.	A. and A.E.E., Boscombe Down: Constructors' Dinner.
Dec.	7.	G.A.P.A.N.: Reception, Mansion House, London.

NUCLEAR-ENERGY PROPULSION

An Examination of its Possibilities for Aircraft and Rockets

By L. N. THOMPSON, B.Sc. Hons. (Eng.) G.I.Mech.E.

WITH the recent announcement in the United States of the successful conclusion of the basic-research stage of the NEPA Project (Nuclear Energy for the Propulsion of Aircraft), and the subsequent placing of a development contract with the Lockheed Aircraft Corporation, Burbank, California, for a four-engined turbo-nuclear-powered bomber, it would be of interest to make a general theoretical investigation into the application of nuclear energy to reaction propulsion in general, rocket propulsion in particular being the logical subsequent step to the turbo-nuclear application, in order of magnitude of engineering problems involved.

That these problems are of different orders of magnitude may well be appreciated when it is recollected that, in an average turbojet, typical chamber conditions might be about 60 lb/sq in Absolute and 1,000 deg Kelvin, together with a mass flow of about 40 lb/sec. For a representative chemical-rocket power-plant, the corresponding figures might be about 300 lb/sq in A and 3,500 deg K, while for large motors such as that of the A.4 the mass flow may be about 250 lb/sec, an increase of over 6 : 1. Pressures and temperatures similar to these latter would have to prevail in an atomic rocket-motor if it were to compete at all favourably with chemical rocket-motors, and the problems introduced thereby, as will be shown later, must inevitably be formidable in the extreme.

There are two main methods by which nuclear energy could conceivably be harnessed for rocket propulsion: (1) the use of nuclear fuel purely as a monopropellant; and (2) use of nuclear fuel to heat an intermediate working fluid which then serves as the ejected propellant.

It is demonstrated subsequently that only application (2) is at all feasible in practice. Other conceivable indirect applications of nuclear energy, such as high-jet-velocity, low-thrust, electronic ion-beam drives, are not considered here, as their only use, should it ever prove possible to develop them, would be for the futuristic purpose of space-drives between interplanetary sub-orbits.

Notation. In the subsequent analysis, the following symbols are used:—

C	Universal gas constant.
c	Velocity of light.
E	Energy yield from mass m_e.
g	Gravitational potential.
J	Mechanical equivalent of heat.
m_e	Mass of nuclear fuel.
m_f	Final mass of rocket.
m_i	Initial mass of rocket.
m_p	Mass of inert propellant.
m_w	Molecular weight of inert propellant.
N	Number of steps in multi-step rocket.
n	Expansion exponent.
P	Density of general propellant.
P_1	Heating-chamber pressure.
P_2	Pressure at nozzle exit.
Q	Waste energy per unit thrust.
R	Mass ratio.
T	Thrust.
T_1	Heating-chamber temperature.
t	Time.
V	Velocity of rocket at any instant.
V_f	Final velocity of rocket.
V_j	Effective jet velocity.
X	Heat potential per unit mass of propellant.
x	Specific propellant capacity of rocket.
y	Volumetric propellant capacity of rocket.
η_i	Internal efficiency of rocket motor.
η_n	Nuclear efficiency.
η_o	Overall efficiency of rocket motor.

Suffixes:—

c	Denotes chemical motor.
n	Denotes nuclear motor.

Method 1: *Use of Nuclear Fuel as a Monopropellant.*—In the following analysis, the assumption is made that pure nuclear fuel could be used as a monopropellant in an atomic motor similar to conventional present-day chemical motors. This assumption is admittedly very great, but as in any event the result of the analysis is to demonstrate the engineering impossibility of such a device on grounds of thermal control, the feasibility of the original assumption is immaterial.

The practical energy yield E from a mass m_e of nuclear fuel is given by:—

$$E=\frac{\eta_n m_e c^2}{\sqrt{1-\frac{V^2}{c^2}}} \quad \ldots\ldots(1)$$

When this fuel is used as a monopropellant in a motor having an overall efficiency η_o, and the flight velocity V is very small compared with c (as would be so in all practical instances), the following holds:—

$$\eta_n\eta_o m_e c^2=\tfrac{1}{2}m_e V_{jn}^2 \quad \ldots\ldots(2)$$

(neglecting the very small mass deficit)

$$\text{i.e., } V_{jn}=c\sqrt{2\eta_n\eta_o} \quad \ldots\ldots(2a)$$

The developed thrust is given by:—

$$T=\frac{d}{dt}\left(m_e.V_{jn}\right) \quad \ldots\ldots(3)$$

(neglecting again the mass deficit).

Under steady conditions, the propellant consumption is therefore given by:—

$$\frac{dm_e}{dt}=\frac{T}{V_{jn}} \quad \ldots\ldots(3a)$$

and the consumption per unit thrust by:—

$$\left(\frac{dm_e}{dt}\right)_1=\frac{1}{V_{jn}} \quad \ldots\ldots(3b)$$

At a motor internal efficiency η_i, the waste energy Q_n liberated to the motor and rocket structure per unit thrust is therefore given by:—

$$Q_n=(1-\eta_i)\eta_n.\frac{1}{V_{jn}}.\frac{c^2}{J} \text{ heat units} \quad \ldots\ldots(4)$$

Substituting in (4) from (2a):—

$$Q_n=(1-\eta_i)\sqrt{\frac{\eta_n}{2\eta_o}}\frac{c}{J} \text{ heat units} \quad \ldots\ldots(4a)$$

By a similar analysis, the corresponding waste energy Q_c per unit thrust for a chemical motor having the same internal and overall efficiencies (which must be so for a true comparison) may be shown to be given by:—

$$Q_c=(1-\eta_i).X.\frac{g}{V_{jc}} \text{ heat units} \quad \ldots\ldots(5)$$

$$\text{By definition: } \eta_o=\frac{V_{jc}^2}{2gJX} \quad \ldots\ldots(6)$$

$$\text{or: } X=\frac{V_{jc}^2}{2gJ\eta_o} \quad \ldots\ldots(6a)$$

Substituting in (5) from (6a):—

$$Q_c=(1-\eta_i)\frac{V_{jc}}{2J\eta_o} \text{ heat units} \quad \ldots\ldots(5a)$$

Then, from (4a) and (5a):—

$$\frac{Q_n}{Q_c}=\frac{c\sqrt{2\eta_n\eta_o}}{V_{jc}}=\text{ratio of jet velocities} \quad \ldots\ldots(7)$$

To obtain the order of magnitude of this ratio, it is necessary to insert numerical values. For all nuclear fuels available at present, η_n is very small, e.g., for uranium, $\eta_n=0{\cdot}0731$ per cent. This value will be assumed here. For the chemical fuel; a representative present-day value of $X=3{,}455$ B.Th.U./lb would give a jet velocity V_{jc} of 7,200 ft/sec at a motor overall efficiency η_o of 30 per cent (corresponding conditions would be a flame temperature of the order of 3,500 deg K

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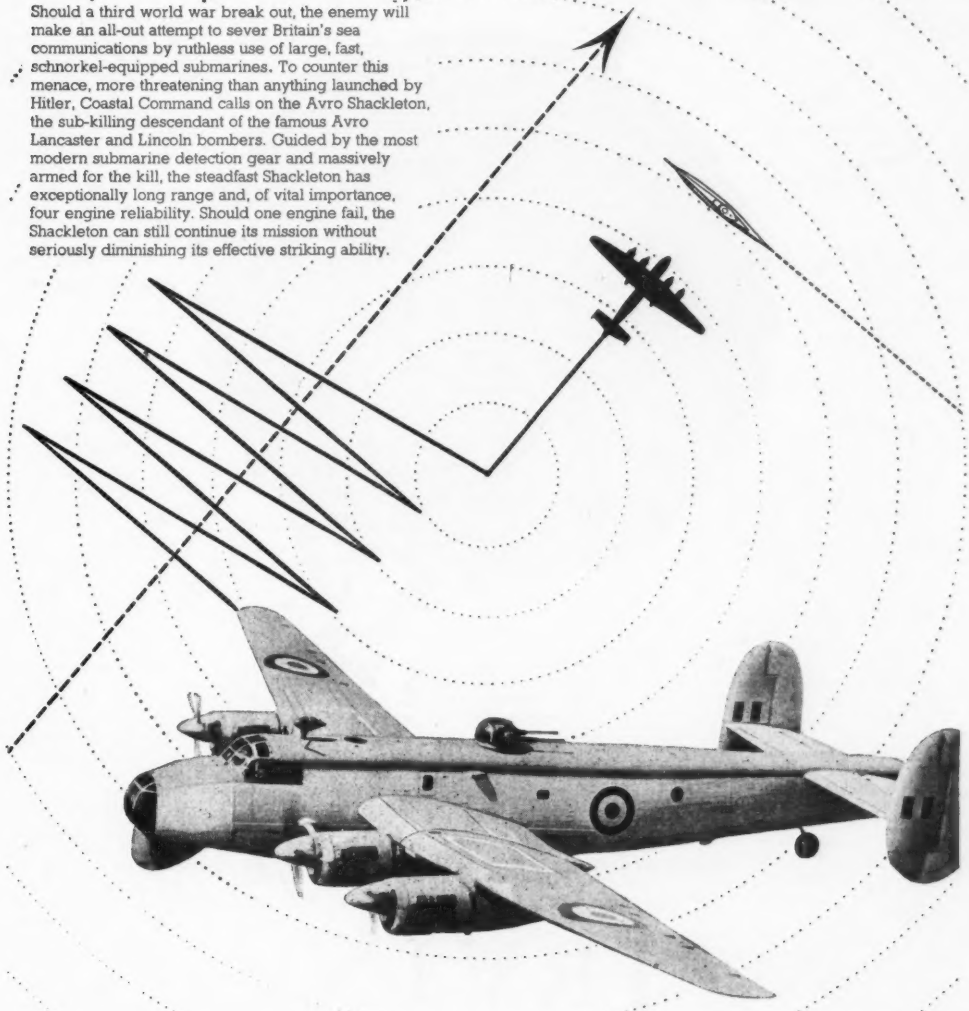

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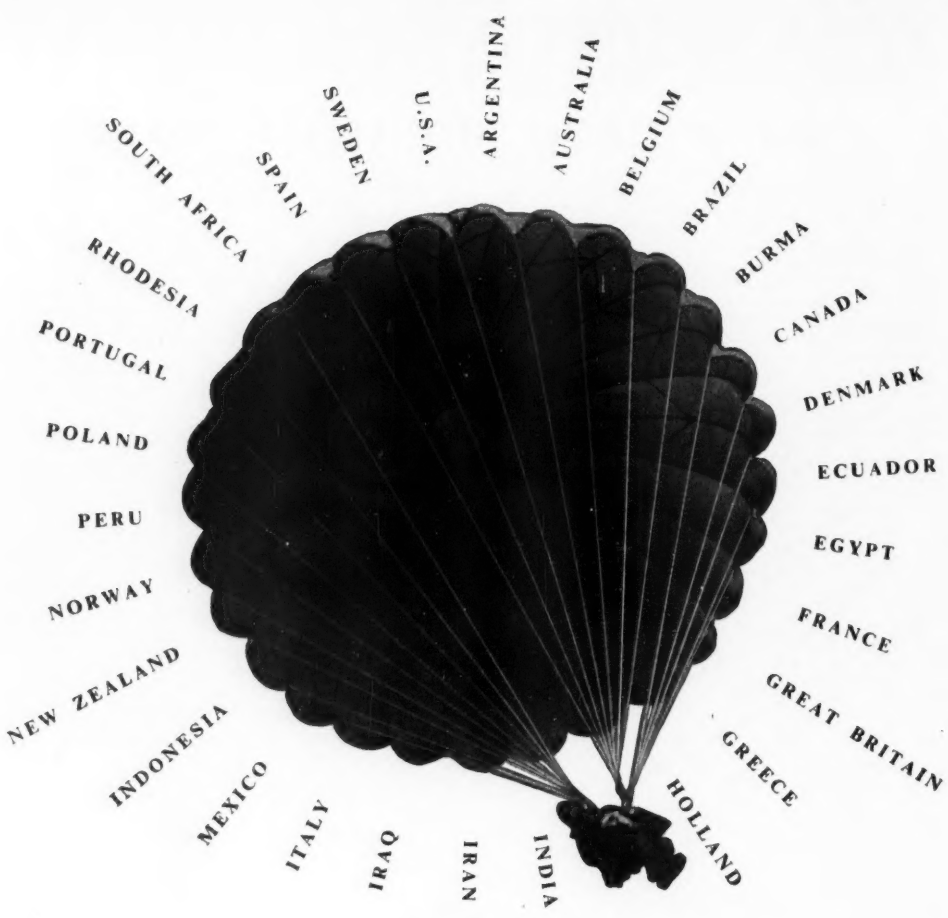

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NUCLEAR-ENERGY PROPULSION . . .

and an expansion pressure ratio of approximately 20:1).

Inserting the above values in equation (7):—

$$\frac{Q_n}{Q_c}=\frac{186{,}000\times 5{,}280\times\sqrt{2\times 0{\cdot}3\times 0{\cdot}000731}}{7{,}200}=2{,}855$$

This result shows that, for two motors, one atomic and one chemical and both developing the same thrust, the atomic motor would give off almost 3,000 times the waste energy given off by the chemical motor. The use of nuclear fuels other than uranium would not alter the order of magnitude. As the waste energy per unit thrust of existing chemical motors such as the above is already about the maximum which can be accepted, it would therefore appear impossible to construct atomic rocket-motors using pure nuclear fuel.

This result is due to the extremely energetic nature of atomic fuels. At the beginning of this analysis, it was assumed for mathematical purposes that pure nuclear fuel could be used in a motor. However, even were this practicable, the energy of the fuel could still only be translatable into kinetic energy by the normal rocket-motor procedure of expansion in a nozzle down from a high initial temperature T_1. If the very high jet velocities predictable by equation (2a) were to be attainable in practice, therefore, it would inevitably be necessary to have fantastically high values of T_1, thus leading to the impossible cooling conditions predicted by equation (7).

From a consideration of equations (4), (5) and (6), noting that $\left(\eta_n\frac{c^2}{\mathcal{J}}\right)\left(\frac{1}{V_{jn}}\right)$ corresponds to $\left(X\right)\left(\frac{g}{V_{jc}}\right)$, it will be appreciated that the factor Q is proportional primarily to the square root of the heat potential of the propellant used, be it either chemical or nuclear. Therefore, as the previous results show, this heat potential must be reduced to a reasonably low figure if atomic motors are to be at all feasible in practice. This brings us naturally to a consideration of method 2, in which the pure nuclear fuel is "diluted" very considerably by the introduction of an inert working fluid or reaction mass.

Method 2: Use of Nuclear Fuel with an Intermediate Working Fluid.—An atomic motor working on this principle can be pictured as a conventional chemical motor with a solid-type reactor installed in the combustion chamber. The inert propellant is pumped into the reactor, heated and then expanded in the nozzle in the normal fashion. The turbo-nuclear engines of the NEPA Project will presumably embody this form of construction. In such a motor, energy is transferred to the gas complex from an external source, as opposed to an internal source with chemical motors and pure nuclear motors. The solid reactor must therefore of necessity be at a higher temperature than the gas complex if positive heat-transfer is to occur. This necessity constitutes a major constructional obstacle.

Proceeding analytically as for method 1, except that a mass m_p of inert propellant is now associated with the mass m_e of nuclear fuel:—

$$\eta_t\eta_o m_e c^2=\tfrac{1}{2}m_p V_{jn}^2 \quad\ldots\ldots(8)$$

(neglecting the mass deficit and m_e, as the ratio m_e/m_p is later shown to be very small at the chamber temperatures permissible)

$$\therefore\ V_{jn}=c\sqrt{2\eta_n\eta_o}\ \sqrt{m_e/m_p} \quad\ldots\ldots(8a)$$

(compare with equation 2a)

$$\text{and}\ \sqrt{m_e/m_p}=\frac{V_{jn}}{c\sqrt{2\eta_n\eta_o}} \quad\ldots\ldots(8b)$$

The jet velocity V_{jn} attainable will be limited by the permissible chamber temperature T_1 and the expansion ratio P_1/P_2, and may be calculated, for conditions of optimum expansion ratio, from the equation:—

$$V_{jn}=\left\{\frac{2gn}{n-1}\cdot\frac{C}{m_w}\cdot T_1\left[1-\left(\frac{P_1}{P_2}\right)^{-\frac{n-1}{n}}\right]\right\}^{\frac{1}{2}} \quad\ldots\ldots(9)$$

To compare with the chemical motor as before, for a given working fluid, it will be necessary to take corresponding values of η_t, η_o, T_1 and P_1/P_2 and calculate V_{jn} from equation (9). Knowing V_{jn}, $\sqrt{m_e/m_p}$ may then be calculated from equation (8b).

To determine the Q ratio, we have as before:—

$$\left(\frac{dm_p}{dt}\right)_1=\frac{1}{V_{jn}} \quad\ldots\ldots(10)$$

And nuclear fuel used per unit mass of propellant $=\frac{m_e}{m_p}$

$$\therefore\ Q_n=(1-\eta_t)\ \eta_n\cdot\frac{1}{V_{jn}}\cdot\frac{m_e}{m_p}\cdot\frac{c^2}{\mathcal{J}}\ \text{heat units} \quad\ldots\ldots(11)$$

Substituting in (11) from (8a) —

$$Q_n=(1-\eta_t)\sqrt{\frac{\eta_n}{2\eta_o}}\sqrt{\frac{m_e}{m_p}}\frac{c}{\mathcal{J}}\ \text{heat units} \quad\ldots\ldots(11a)$$

(compare with equation 4a).

Then from (5a) and (11a):—

$$\frac{Q_n}{Q_c}=\frac{c\sqrt{2\eta_n\eta_o}}{V_{jc}}\sqrt{\frac{m_e}{m_p}} \quad\ldots\ldots(12)$$

(compare with equation 7).

Table I gives the result of calculations based on the above for two working fluids, hydrogen and water (as superheated steam). It has been assumed in these calculations that $T_1=3{,}500$ deg K, $P_1=300$ lb/sq in A and $P_2=15$ lb/sq in A, and that dissociation effects cancel out losses and imperfect flow effects in the nozzle.

TABLE I

Working Fluid	V_{jn} ft/sec	$\sqrt{\frac{m_e}{m_p}}$	$\frac{Q_n}{Q_c}$
H_2	25,180	$1{\cdot}224\times10^{-3}$	3·495
H_2O	8,660	$0{\cdot}421\times10^{-3}$	1·201

Table I shows that power-dissipation problems for Method 2 rockets would be very much less than for those of Method 1. This, of course, is because of the greatly reduced heat potential of the inert propellants. The table also shows, however, that the magnitude of the power-dissipation problem would depend on the particular working fluid used. For example, the problem is worse when using a lighter working fluid (hydrogen) than when using a heavier one (water). This result is due to the higher specific heat of the hydrogen allowing it to absorb more heat for a given chamber temperature T_1 than the water. This effect corresponds to the hydrogen having a higher heat-potential than the water, hence the cooling problem is worse.

It would therefore appear that atomic motors using an intermediate working fluid would be feasible on grounds of cooling problems, and that the use of a heavier working fluid would definitely be preferable in such motors. How this latter requirement would affect the overall performance of the rocket will now be considered.

The fundamental equation governing rocket performance is:—

$$V_f=V_j\log_e R \quad\ldots\ldots(13)$$

(neglecting gravitational and air-resistance effects).

The effective mass ratio R of a single-step rocket may be written in the form:—

$$R=\frac{m_i}{m_f}=\frac{m_f+yP}{m_f}=1+xP \quad\ldots\ldots(14)$$

Substituting in (13) from (14):—

$$V_f=V_j\log_e(1+xP) \quad\ldots\ldots(13a)$$

Equation (13a) enables the effect of the density of the working fluid on the rocket performance to be calculated, the parameter V_f being, of course, the one on which interest is primarily focused for practical purposes. The results of some such calculations are given in Table II for various types of rocket-drive.

Table II shows that, judged on a basis of attainable velocity V_f, an atomic motor employing water as a working fluid has a performance superior to that of all others considered. The ethyl-alcohol motor comes second, being better than either of the hydrogen motors, each of which has roughly the same performance.

It is shown that it is difficult to obtain high mass-ratios when using propellants of low density, and this disadvantage may more than cancel, in regard to attainable velocities, the

NUCLEAR-ENERGY PROPULSION . . .

TABLE II

Type of drive		Chemical (a) 75 per cent ethyl alcohol + liquid oxygen	Chemical (b) Liquid hydrogen + liquid oxygen mixed in "rich" ratio	Atomic (c) Liquid molecular hydrogen	Atomic (d) Water	Chemical (a) 75 per cent ethyl alcohol + liquid oxygen	Chemical (b) Liquid hydrogen + liquid oxygen mixed in "rich" ratio	Atomic (c) Liquid molecular hydrogen	Atomic (d) Water
Particulars of drive	V_j ft/sec	7,200	12,000	25,180	8,660	7,200	12,000	25,180	8,660
	ρ lb/cu ft	60	12	4·5	62·5	60	12	4·5	62·5
		Mass ratio attainable, $(1 + x^P)$				Velocity attainable, V_f, ft/sec			
Specific propellant capacity x, cu ft/lb	$\frac{1}{20}$ *	4	1·6	1·225	4·125	9,980	5,640	5,110	12,280
	$\frac{1}{10}$	7	2·2	1·45	7·25	14,000	9,460	9,350	17,150
	$\frac{1}{5}$ †	13	3·4	1·9	13·5	18,450	14,680	16,160	22,500

* This is approximately the value attained with existing large rockets which have been used operationally.

† This value will be difficult to attain.

advantage of the higher jet velocities obtainable in general from such propellants.

The most noteworthy fact, however, is that atomic motors, whatever the working fluid used, cannot give any performance which is appreciably better than that of corresponding present-day chemical motors (for example, compare the water and ethyl-alcohol motors, and also the two hydrogen motors). That this must be so is evident when one considers that, with existing temperature limitations in the chamber, it is quite immaterial whether the working fluid is heated by nuclear or molecular reactions, as the above limitations prevent nuclear energy from being used to anything like its full extent. In fact, it can only be used to the same extent (i.e. magnitude of heat potential) as chemical fuels.

With regard to the parameter x used in Table II, it is, of course, true that lower-density propellants would to some extent permit a lighter rocket structure for a given propellant volume, but it is not considered that this effect would be very great. For two similar rockets carrying similar payloads but using different propellants, the two structures would have to be much the same for reasons of mechanical rigidity and by virtue of their both being designed for the same aerodynamic loading.

The conclusions drawn from Table II apply equally well to multi-step rockets, as for an N-step rocket of which each individual step has an effective mass ratio R, the overall V performance is merely N times that of a single-step rocket of mass ratio R.

The conclusions would also not be altered by correcting equation (13a) to allow for gravitational and air-resistance effects, as for similar rockets these effects would be similar. Any difference in air resistance would, in fact, favour the rocket carrying the propellants of higher density.

It may therefore be concluded that heavier working fluids are preferable on all counts in atomic rockets, though even when this condition is satisfied little advantage in performance is gained over conventional chemical rockets. The case for atomic rocket motors is much weaker than for turbo-nuclear motors, for which an infinite supply of working fluid (air) is available. In this latter instance, an "everlasting" nuclear power source is of great advantage from the viewpoints of both fuel economy and flight range, but this is not so for the rocket application, where the supply of working fluid is strictly limited. The only possible advantage of nuclear energy in this application is for the attainment of higher heat potentials, but as these cannot be handled in any event (at present, at least), this advantage is therefore nullified at birth.

Constructional Prospects for Atomic Rockets.—It has already been demonstrated that rockets using pure nuclear fuel as a propellant are a constructional impossibility. It remains to examine these prospects for Method 2 rockets:—

Temperature.—It has been assumed for comparative purposes in the foregoing that gas temperatures of 3,500 deg K could be attained. This is a much greater temperature than is permissible in any existing reactors; indeed, it is equal to, or greater than, the destruction temperature of practically all materials at present used in reactor construction, both fuels and moderators. Apart from the obvious difficulties of operating reactor control gear, etc., at these elevated temperatures, it is therefore very unlikely that atomic motors will, in the near future, be able to operate at gas temperatures even equal to those of present-day chemical motors, let alone at higher temperatures. This temperature problem is, of course, much less severe in turbo-nuclear motors operating at a chamber maximum of about 1,000 deg K or possibly much less.

Pressure.—It is not anticipated that this problem would be any more severe than in chemical motors.

Pumping.—The high rate of propellant-flow characteristic of rocket motors would give rise to a pumping problem of considerable magnitude when associated with the conventional reactor design of long, narrow passages in a honeycomb structure.

Structural.—As the ratio m_c/m_p is very small, the fissile material would have to be very finely diffused in order to give the necessarily large heat-transfer surface. This would be very difficult to achieve satisfactorily from both the structural and criticality aspects.

Radiation.—The intense nuclear radiation might well adversely affect the materials of both reactor and motor, which materials would already be subject to the deleterious effects of high temperatures and eroding contact with the high-velocity gas propellant stream.

Specific Propellant Capacity.—As the weight of a rocket reactor system and shielding is not likely to be less than that of a corresponding chemical motor and auxiliaries, it is therefore improbable that an atomic rocket will show any improvement in specific propellant capacity over its corresponding chemical counterpart.

It will be appreciated from the above paragraphs that the constructional prospects of high-temperature atomic motors are not very bright.

Conclusions.—The discussion may be summed up as follows:—

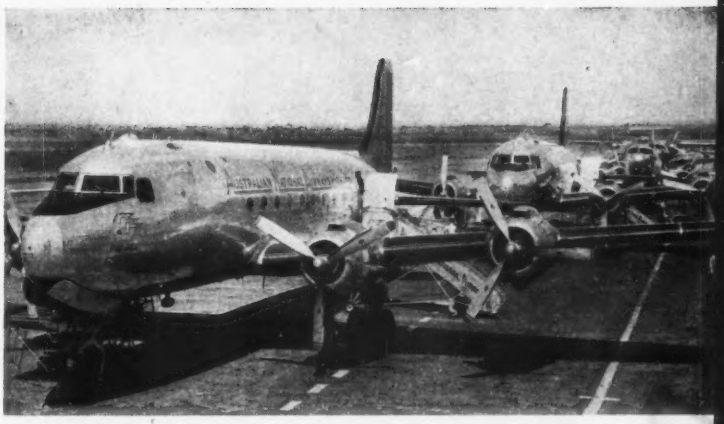
(1) Atomic rocket motors using pure nuclear fuel as a monopropellant are not feasible.

(2) Atomic rocket motors using nuclear fuel to heat an inert propellant are feasible, but their future as a serious competitor to chemical motors depends on their being developed so as to be capable of operating at gas temperatures over 3,500 deg K. There appears to be very little hope of this objective being attained in the near future.

(3) Turbo-nuclear motors offer great advantages in fuel economy and flight range as compared with existing aircraft power plants, and the development problems involved are much less severe than for the rocket application in all respects—temperature, pressure and mass flow.

(4) Compared with (3), there is a relatively weak case for developing atomic rocket motors for general-purpose applications.

CIVIL AVIATION



NOON DOWN-UNDER: Skymasters, Dakotas, and —in the background—a Bristol Freighter of Australian National Airways ranged at Essendon. The time (as will be deduced from the shadows) is midday. Between 7 and 8 o'clock in the morning as many as 13 A.N.A. machines can be seen waiting to load and depart, and that business is generally brisk is borne out by the January-June, 1951, flying time and passenger-totals—60,659 hours and 354,730 persons respectively.

ATLANTIC "TOURISM"—THE BACKGROUND

THE forthcoming meeting of international airline representatives at Nice on November 27th, at which North Atlantic tourist fares are to be discussed, is expected to result in a final decision on this controversial and highly important subject. The present position is an anomalous one in which, because of the absence of complete international agreement, P.A.W.A. has taken a unilateral decision to introduce low-cost fares ($405, or £142, for the round trip) next spring—an action which B.O.A.C.'s chairman, Sir Miles Thomas, recently termed "a very adolescent and naive approach to what is, after all, a strictly commercial problem." Other airlines operating on this route have individually made tentative suggestions for similar rates. T.W.A. and B.O.A.C. have suggested a one-way fare of £95 and a return ticket for £142, as compared with the present £141 single and £254 return rates.

In spite of this discord over details, however, it is clearly apparent that almost all of the regular airlines operating over the Atlantic are enthusiastic about the possibilities of the vast potential market which tourist rates open up, and the conference at Nice will probably stand as one of the milestones of air transport.

The forthcoming discussion will take place within the I.A.T.A. conferences which, on the basis of the Bermuda Agreement of 1946, have to date constructed an international rate-pattern covering the operations of 62 members on routes within and connecting all continents. The basic machinery for determining these rates is relatively simple. Proposed fares are based on studies of costs and other factors by specialist committees. They are examined both independently and in relation to the world-wide pattern in the full conference sessions, which are made up of representatives of each airline concerned in a given route. If a fare or rate can be agreed upon by unanimous vote in the conferences, it is then passed to the interested governments for approval, and if all governments concerned approve, it then becomes effective.

On the other hand, if one airline votes "no," or one government disapproves, the agreed rate falls and an airline operating over the route in question can charge whatever its own government—or the government to whose territory it flies—may countenance.

The tourist fare question has had an interesting case-history in both conference and government procedures. Over the past several years, the trend of conference action, particularly with regard to the important North Atlantic route between the United States and Europe, has been toward greater flexibility in fare structures, in order to even out the seasonal fluctuations in traffic and to encourage tourist flow to Europe during the "off season."

In 1950, a special transatlantic excursion fare on regular services of one and one-tenth times the one-way fare was introduced, and at Bermuda last May the present proposals for a second level of service over the North Atlantic were formally voted on.

At that time, the airlines concerned voted unanimously to inaugurate experimental tourist services across the North Atlantic in October, 1952. They agreed that the service would be considered in the nature of a "controlled experiment" for the first six months and that during that time each company, if it wished, could run from four tourist services per week, in addition to its regular schedules. The price was to be set between $225 and $250, depending on the exact findings of a special committee which was to study the question of costs, the number of extra seats which could be installed in tourist aircraft, and other variations which might be permitted from the regular standards of comfort.

The recommendation of the Bermuda Conferences was approved by all interested governments except two—the United States and Switzerland—and, failing their approval, it could not become effective. The principal objections raised were to the frequency limitation, to the fact that a price had been set without prior agreement on definite seating capacity, and to the fact that the 1952-53 tourist fares had been included in the same conference resolution as the normal fare structure for the year 1951-52.

After the latter objection had been met by the passing of a separate resolution for the regular 1951-52 fare structure by means of a mail vote, the transatlantic carriers immediately interested were delegated to seek an alternative agreement on tourist fares.

At London in September they met again in the hope that they could recommend a fare agreement which could be submitted to the full conference membership for approval by a mail vote. The terms by which governments concerned had disapproved the original agreement, however, removed the principle of frequency limitation during the experimental period; and in these altered circumstances it was felt that the matter should have more study and consideration by the full conference.

This, then, is the background to the momentous decisions which are expected of the forthcoming session at the Hotel Negresco in Nice on November 27; it will probably last for about two weeks.

Technically, the tourist fare question will be put to the joint session of I.A.T.A. Traffic Conferences 1 and 2, which have jurisdiction over routes between the Western Hemisphere (Conference 1 area) and Europe, Africa and the Middle East (Conference 2). Representatives of other carriers, whose rates and fares tie in with the transatlantic structure, will also be present. As far as the actual problems of agreement in the conference sessions are concerned, the following comment by Sir Miles Thomas, as president of I.A.T.A., in an address at Boston of interest :—

"I do not believe that you will differ with me if I suggest to you that the major considerations in regard to tourist travel by air include such factors as standards of comfort, dependability and punctuality. Equally, it is essential if the airlines are going to have the confidence of the taxpayers or stockholders, as the case may be, that the reduced rate for tourist travel should be economically practical. When we do reach agreement in I.A.T.A., that fare will be attractive to the tourist and economically practical to the airlines."

REPORTING THE WEATHER

THE recently published *Annual Report of the Meteorological Office*,* presented by the Meteorological Committee appointed by the Secretary of State for Air, contains a wealth of information on the varied techniques and wide range of equipment now used in this country in the effort to provide a regular and reliable weather forecasting service. Overlooking for a moment the much-lamented loss of Airmet, it can be said that the British meteorological service covers the needs of the R.A.F., civil aviation, the Merchant Navy, a number of Government departments and a wide cross-section of public and industrial interests.

Among important changes made during the year which concern aviation were the opening of new met. offices to meet the requirements of the expanding R.A.F. and the inauguration of a new system of met. broadcasts by R/T. to conform with the changed practices of airline operators. The report discloses, also, that the number of stations making synoptic reports decreased during the

*H.M. Stationery Office, Price 11. 6d.

CIVIL AVIATION . . .

period under review by six; the total is now 163. Most of these stations are located on airfields and are manned by personnel of the Meteorological Office, but this number also includes 46 auxiliary stations where the observers carry out their duties on a part-time basis.

Some idea of the extent of the present weather-reporting network can be obtained from the fact that a voluntary observing fleet of 600 ships now makes reports from all oceans to meteorological centres at regular synoptic hours. The Central Forecasting Office alone receives reports from 105 ships daily, 52 per cent of the reports being received within one hour of the time of observation. Trawlers, coastal vessels and light vessels are among those contributing to this marine information service. During the year each of the four British ocean weather-ships in the North Atlantic completed three years of service. The ships have carried out a full programme of work, including surface and upper-air observations transmitted to the Central Forecasting Office by point-to-point W/T. Navigation aids provided by these ships were regularly used by both civil and R.A.F. machines; in fact, a total of 3,534 aircraft made use of them during the year.

Routine reconnaissance flights continued to be made by Hastings and Halifax aircraft of the R.A.F., operating over the Eastern Atlantic from Aldergrove and Gibraltar and over the Indian Ocean from N'Gombo, Ceylon: in addition, Mosquitoes of Fighter Command flew from several alternative bases in the U.K. to obtain detailed information on cloud structure, temperature and humidity at a number of levels. Radio-sonde and radar wind-station observations continued at high pressure, though a shortage of staff prevented the full programme of ascents from being carried out.

The report mentions also that new types of equipment now being developed will ensure greater range and accuracy in the sounding of the upper air. Special ascents were made regularly, in order to determine winds above the levels normally sounded, and heights greater than 100,000ft were achieved on a number of occasions. During the year, also, the new combined thunderstorm-location and radio-sonde station at Hemsby became operative and four other stations engaged in the direction-finding of atmospherics continued to function.

On the communications side, according to the report, the meteorological teleprinter network within the U.K. now distributes basic data by "first channel" broadcast from Dunstable to 155 stations and supplementary data by "second channel" broadcast to 58 sub-centres and important airfields. Among details of services relating primarily to civil aviation, the report mentions a special study which was undertaken of the met. requirements for jet aircraft. It also states that the necessary modifications to the standard met. procedures have now been worked out in preparation for the introduction of Comets on regular schedules.

Mention is made, in the report, too, of the special experiments which were conducted during the year to ascertain how much of a runway or its lighting system a pilot can see when landing in bad visibility. In detailing numerous other aspects of Meteorological Office activity the report says that some 629 candidates were examined for the issue of various aircrew licences. Incidentally, the total cash provision set aside in the 1950-51 Air Estimates for meteorological services amounted to £2,250,000.

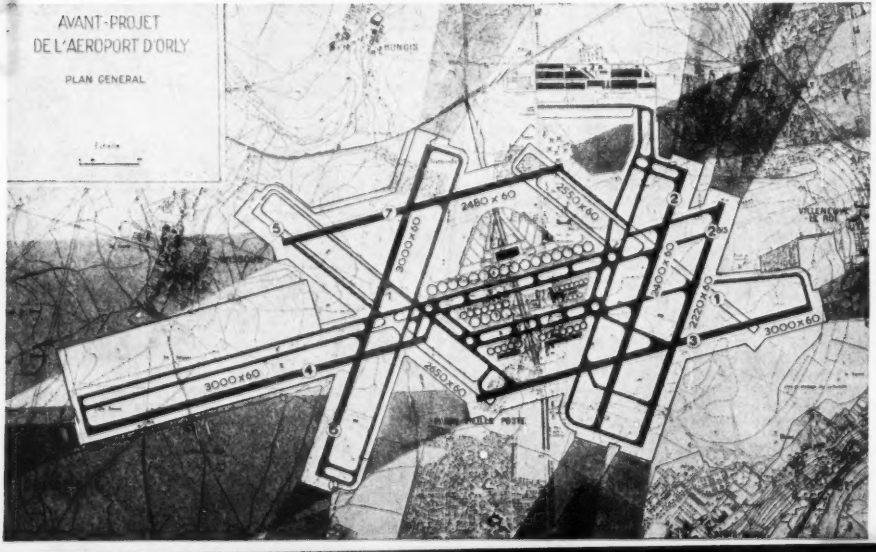
We hope to include in a forthcoming issue a more detailed summary of some of the special equipment now being used, together with some information on current research programmes.

SOLENT FOR TRANS-OCEANIC: The fourth ex-B.O.A.C. Short Solent flying-boat to be acquired by Trans-Oceanic Airways this year left Belfast on Monday, November 12th, on its delivery flight to Sydney. Named "Somerset," it will augment its three sister craft on the company's Pacific Islands' routes. The photograph above shows members of the "despatching party" immediately before the take-off.

B.O.A.C.'S COMET LEADER

LAST week B.O.A.C. announced the appointment of Capt. A. P. W. Cane to the important post of Operations Superintendent, Comet Unit. In this capacity he will be responsible to the manager of the unit for all operational aspects of the introduction of this type of aircraft into regular service. Capt. Cane, who is 37 years of age, served as a pilot in the R.A.F. from 1933 to 1939. He then spent a short time with Scottish Aviation, Ltd., before returning to the Service in 1940. After being seconded to B.O.A.C. as a first officer in 1941, he served at Asmara and Cairo, where he was mainly engaged on supply work for the armies in the Western Desert. For this he received, in 1943, a Commendation for Valuable Service in the Air.

Capt. Cane became one of the Corporation's senior captains in 1946 and was later appointed Flight Captain, No. 2 Line. He was then placed in charge of the introduction of Constellation 749s and Argonauts, and since the beginning of last year has superintended the Eastern Flight of No. 1 Line, which operates Argonauts between London and the Far East. An Associate of the R.Ae.S. and a member of the Institute of Navigators, Capt. Cane is also the holder of a British Master Pilots' Certificate; in 1948 and 1949 he served as chairman of B.A.L.P.A.



FUTURE OF ORLY: During a recent visit to France we found that considerable progress has now been made in the development of Orly Airport, despite financial difficulties. These have entailed modification of the previous plan (see "Flight," August 3rd) and the revised arrangements are shown in this new diagram. Work which will definitely be completed during the first five-year programme includes Runways 2, 2bis, 3 and 7; Nos. 4 and 6 may be built later. Runways 5 and 1 will be constructed only if the provision of a direct approach for jet aircraft is necessary.

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CIVIL AVIATION . . .

BREVITIES

WHEN the forthcoming retirement of Dr. Albert Roper as Secretary-General to I.C.A.O. takes effect on January 1st, the post will be filled by Mr. Ernst Carl Ljungberg, director-general and president of the Swedish Board of Civil Aviation.

* * *

Speaking in New York last week, the chairman of B.O.A.C., Sir Miles Thomas, predicted that Comets (the Mk. II versions with Avons) would be plying between London and New York in about 2½ years' time.

* * *

A discussion took place in Dublin recently between Aer Lingus and a deputation from the Welsh Advisory Council for Civil Aviation on the possibility of inaugurating services between Dublin and Wales next summer.

* * *

Traffic statistics of Swissair for the third quarter of 1951 are said to show an encouraging increase when compared with those for the corresponding period of last year. The total of passengers flown amounted to 102,661, and the total number of kilometres flown to 3,548,742. Regularity achieved was 99.2 per cent.

* * *

T.W.A. has now taken delivery of its first Martin 4-0-4—the type which is destined for medium- and short-haul service on the company's coast-to-coast routes. The 4-0-4 is powered by two 2,400 h.p. Pratt and Whitney engines and cruises at 300 m.p.h. Integration with regular schedules will not take place until early next year.

* * *

The French SIPA 200 jet-powered private trainer, which caused so much interest at the last *Salon de l'Aéronautique* in Paris earlier this year, is scheduled to make its first flight this month at Suresnes. It is expected to have a cruising speed of about 225 m.p.h. and a duration of between one-and-a-half and two hours.

* * *

The Australian Department of Civil Aviation has decided to built a new airfield at Lara, near Laverton (Victoria), intended particularly to accommodate jet aircraft. Its estimated cost is £3,000,000. Plans include a concrete runway of 7,500ft with a 2,500ft overrun. It is intended eventually that the aircraft factories now located at Fisherman's Bend will be moved to the new site.

* * *

Two aircraft recently purchased from W. S. Shackleton, Ltd., are now being ferried long distances to their destinations abroad. A Gemini, VR-SDC, is being flown to Singapore by an Australian businessman, Mr. N. G. Padgett, with his wife as passenger; and a Proctor, G-AIEV, is being flown out to Somerset Airways of Muttaburra, Queensland, by Mr. Loxham, formerly of Loxham's Flying Services, Ltd., Blackpool.

* * *

S/L. C. W. Roberts, chief air navigation officer of the School of Navigation at University College, Southampton, has been seconded to I.C.A.O. for three months to assist in carrying out a number of training and development missions which are part of the United Nations Technical Assistance programme for under-developed countries. S/L. Roberts' duties will be mainly concerned with the compilation of detailed training memoranda.

* * *

Rumours emanating from South America that Western Germany is planning to resume airline services to that country were supported recently by the Allied authorities' announcement in Bonn that Germany will be allowed to operate her own civil airline when she is accorded her new status of equality within the European community. At present Western Germany owns and administrates a number of civil airports, but the flying and most of the technical responsibility is in the hands of the Allies.

* * *

The American C.A.B. has pledged itself to build "a vast non-luxury network of air services cheap enough for all Americans to use." In a statement of its policy published recently in Washington, the Board said that the regular U.S. airlines now have adequate facilities to establish inexpensive transcontinental "coach" services. We quote the C.A.B.'s own words : "There is no justification for a national policy which pours millions of dollars of public money into building up an extensive air-transport system if use of that system is to be permanently restricted to persons of means and denied to the masses of the populace."

* * *

Capital Airlines, American domestic operators, have placed a contract with K.L.M. for modifications to the L-749 Constellations which the American company will be taking over when K.L.M. receives its Super Constellations as replacements. The alterations include radical changes to the main cabin, and the whole of the work is being carried out at Schiphol.

* * *

A report from Rome suggests that the only wholly nationalised airline, Ali-Flotte Riunite, will shortly be absorbed by the Italo-American company, Linee Aeree Italiane.

* * *

A new service between Afghanistan and India was due to begin yesterday. It is being operated by an Indian airline from Ahmedabad to Kabul (Afghanistan) *via* Persia, as Pakistan is understood to have objected to the principle of Indian aircraf. flying over her western frontier.

* * *

The second prototype of the S.O.1120 Aerial III tip-jet helicopter flew for the first time at Villacoublay on October 20th. This flight and subsequent trials with this higher-powered version of the Ariel are said to have been highly successful.

* * *

On November 21st the I.C.A.O. Facilitation Committee was due to hold a meeting at Buenos Aires to review progress made to date in I.C.A.O.'s campaign for the simplification of international formalities affecting airlines and passengers. The United Kingdom delegation of the meeting is headed by Mr. L. C. Nash, O.B.E., of the M.C.A.

* * *

For "distinguished service to aviation safety" Mr. E. S. Calvert, a Principal Scientific Officer with the Royal Aircraft Establishment, has received the annual award of the American Flight Safety Foundation for the development of "texture and contrast in the centre-line approach light system." It will be recalled that Mr. Calvert was responsible for the development of the now widely used "line-and-bar" system of high-intensity approach-lighting.

* * *

To fulfil a recently concluded contract, Silver City Airways are to fly some 1,800 cows across the English Channel between Lympne and Le Touquet. A Bristol Freighter will take off every 90 minutes throughout the daylight hours and the cattle will be transported at a rate of 300 per week for six consecutive weeks. The cattle are on their way from Ireland to Italy. This contract is the largest of its kind ever awarded in this country.

* * *

A contract between Vickers-Armstrongs, Ltd., for the sale of four Viscounts to Aer Lingus has now been officially signed. Deliveries are scheduled to start in 1954 and the total value of the contract is approximately £800,000. It is also reported that negotiations are under way between Air France and de Havillands for the purchase of three Ghost-powered Comets. It will be recalled that this airline has already ordered 12 Viscounts, to be delivered in 1953/54.

* * *

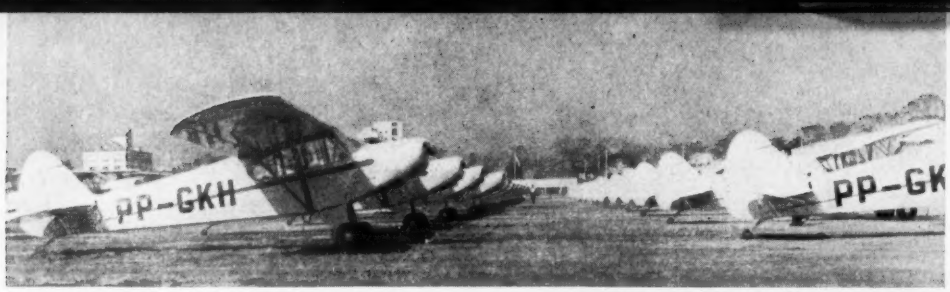
The chairman of the Scottish Advisory Council for Civil Aviation said in Edinburgh last week that provisional arrangements were being made for additional air services to that city next year, including a resumption of the London-Edinburgh-Aberdeen flights which would link up with Orkney and Shetland. He indicated that it was hoped to resume morning and evening services between Edinburgh and London, and that Vikings and Ambassadors would be able to use the extended runways at Turnhouse.

* * *

Although the total of air-transport movements recorded at U.K. airfields in September was fewer than that for the corresponding month for the previous year, the total number of passengers embarking or disembarking on international services showed a 29 per cent increase over the figure for September, 1950. Freight traffic rose by 50 per cent to 5,227 short-tons. The total number of passengers handled, including those in transit, was nearly 343,000. Charter movements, incidentally, decreased by 34 per cent.

* * *

Obviously intent on having "live specimens" on which to work, the Purdue Research Foundation (affiliated to the Purdue University of Indiana) has applied to the American C.A.B. for permission to purchase Midwest Airlines, which they would use as a "laboratory for the study of airline transport." The airline, a small domestic operator, is said to have agreed upon a price of $69,000 (£24,000). If the purchase is approved, the Foundation wants to buy DC-3s to replace the company's present equipment and has also set aside a further $1,000,000 for the purpose of extending the company's present operations.



PRIVATE AIR FORCE : Brazil, it seems, is yet another country in which private flying is encouraged by State-subsidy in the form of equipment and a pre-paid proportion of the instruction fees charged to students. The photograph above was taken just before 80 Piper Super Cubs, recently purchased by the Brazilian Government, took off from Rio de Janeiro for delivery to clubs located throughout Brazil. In the right-hand photograph, President Getulio Vargas is seen christening one of the machines in the approved fashion. Delivery of these 80 Cubs brings to 600 the number of Piper aircraft which to date have been sent to Brazil.

CLUB AND GLIDING NEWS

WITH justifiable pride the Herts and Essex Aero Club has reported that for the first ten months of the year the total of hours flown reached 3,354, making a grand total of some 16,705 hours since the end of the war. During October, some 279 hours were flown.

Miss E. J. Howard recently became the Club's third woman member to obtain a licence since the war, and four others are now well advanced with their training. Others to obtain licences during the month were Messrs. R. Dokumbilek (of Turkey), E. Gaines (from America), S. W. Harrison, F. R. Marquardt, W. R. Piggin, W. D. Silver and P. Winter (of Persia). First solos were carried out by Messrs. C. Ewens, E. V. Heath, A. C. Swire and D. Wetton.

On Friday, December 7th, the club will hold its annual dinner and dance at the Park Lane Hotel, Piccadilly. The chairman will be Mr. A. R. Saward, who was one of the earliest members to learn to fly at the club and who served as a flying instructor in the R.A.F. throughout the war. He has since been an honorary flying instructor at Broxbourne. The guest of honour will be the Secretary of State for Air, Lord De L'Isle and Dudley, V.C.

Tickets, obtainable from the Club's secretary, will cost 2 gns each, and members of other clubs are also being invited to support what is now considered one of the most important functions in the winter calendar. We understand that the Fairoaks Flying Club has already reserved 30 tickets and it seems likely that the accommodation of the Park Lane Hotel's Ballroom will, as last year, be taxed to capacity.

FROM Spain we hear that gliding clubs are already putting their star crews through intensive training in preparation for the International Gliding Contests which are to be held in that country—actually at Huesca—next year. Special attention is being paid to the triangular goal flights and in the Contests themselves, Spanish pilots will obviously stand to benefit considerably from the experience they will by then have acquired in soaring over the major circuits. There are indications that, on the social side, the reception accorded to visitors and competitors from other nations will, in keeping with the Spanish tradition, be particularly sumptuous, and even now many of the initial preparations are under way.

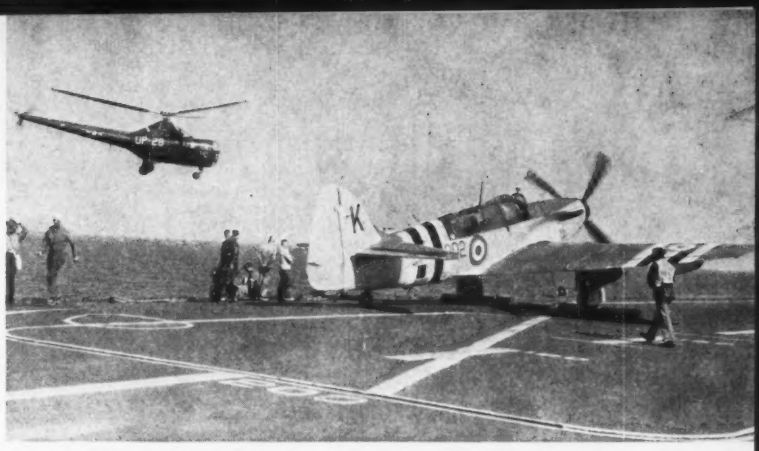
R.Ae.C. AVIATORS' CERTIFICATES

WE publish below another of the periodical lists of those who have qualified for R.Ae.C. Aviators' Certificates; it covers the period from October 4th to October 29th. The previous list (mid-September to the beginning of October) appeared in last week's issue.

No.	Name	Club or School	Date
27,637	D. K. Young ...	Central Flying Group ...	4.10.51
27,638	D. H. O'Brien ...	R.A.F., Cottesmore	4.10.51
27,639	M. Watson ...	Qualified Service pilot ...	4.10.51
27,640	E. Y. Fitzakerly ...	Qualified Service pilot ...	4.10.51
27,641	M. A. Vickers ...	Qualified Service pilot ...	4.10.51
27,642	H. J. Granger ...	Hampshire Aeroplane Club ...	4.10.51
27,643	K. B. Hallam	Northamptonshire Aero Club ...	4.10.51
27,644	M. Chesses	Midland Aero Club	4.10.51
27,645	F. W. Tyler	Midland Aero Club	4.10.51
27,646	F. R. Marquardt ...	Herts and Essex Aero Club ...	8.10.51
27,647	A. W. D. Hudgell ...	Qualified Service pilot ...	8.10.51
27,648	H. Louden	Qualified Service pilot ...	8.10.51
27,649	W. R. Piggin ...	Herts and Essex Aero Club ...	8.10.51
27,650	P. J. White	London Aeroplane Club ...	8.10.51
27,651	J. G. Milne	Strathtay Aero Club ...	8.10.51
27,652	B. Froehlich	Qualified Service pilot ...	8.10.51
27,653	K. J. Stewart	Qualified Service pilot ...	8.10.51
27,654	A. J. C. Pledger ...	Qualified Service pilot ...	8.10.51
27,655	R. S. R. Skelton ...	Qualified Service pilot ...	8.10.51
27,656	H. Ramsay	Qualified Service pilot ...	8.10.51
27,657	G. F. Gill	Qualified Service pilot ...	8.10.51
27,658	P. D. Smith	No. 22 F.R.S., Cambridge ...	11.10.51
27,659	R. Surman	Northants Aero Club ...	11.10.51
27,660	J. T. Thomassen ...	Royal Aero Club	10.10.51
27,661	I. J. S. Russell ...	Strathtay Aero Club ...	11.10.51
27,662	D. Palmer	Newcastle Aero Club ...	11.10.51
27,663	G. C. Lewis	Redhill Flying Club	11.10.51
27,664	B. J. Payne	Lancashire Aero Club	11.10.51
27,665	G. R. Jackson	Blackpool and Fylde Aero Club ...	11.10.51
27,666	A. L. Bailey	Redhill Flying Club	15.10.51
27,667	M. W. Perryman ...	Rochester Flying Club	15.10.51
27,668	J. W. Cox	Elstree Flying Club	15.10.51
27,669	H. W. Thompson ...	Auster Flying Club	15.10.51
27,670	H. G. Mitchell ...	Portsmouth Aero Club	15.10.51
27,671	P. Stowell	Rochester Flying Club	15.10.51
27,672	R. N. F. Harrison ...	Newcastle Aero Club	15.10.51
27,673	D. G. Loader ...	Hampshire Aeroplane Club ...	15.10.51
27,674	C. R. Chrisp	London Aeroplane Club	15.10.51
27,675	P. F. Hobley	R.A.F., Cottesmore	15.10.51
27,676	W. D. Silver	Herts and Essex Aero Club ...	16.10.51
27,677	C. F. Thompson ...	R.A.F., Syerston	18.10.51
27,678	W. S. L. Rennie ...	R.A.F., Syerston	18.10.51
27,679	J. A. Torrance ...	Qualified Service pilot	18.10.51
27,680	E. Fermor	Redhill Flying Club	18.10.51
27,681	R. D. Bradley	R.A.F., Syerston	18.10.51
27,682	B. Farley	R.A.F., Syerston	18.10.51
27,683	F. R. Bywater	R.A.F., Syerston	18.10.51
27,684	A. D. Hare	Strathtay Aero Club	18.10.51
27,685	S. W. Harrison ...	Herts and Essex Aero Club ...	22.10.51
27,686	H. J. Senn	Northants Aero Club	22.10.51
27,687	J. S. Bill	Wolverhampton Aero Club ...	22.10.51
27,688	S. Edwards	Cowes Aero Club	22.10.51
27,689	P. A. Burford-Brown ...	West London Aero Club	22.10.51
27,690	J. A. Lawrence ...	Redhill Flying Club	22.10.51
27,691	R. W. Glover ...	Liverpool Flying Club	22.10.51
27,692	K. W. Beech	Liverpool Flying Club	22.10.51
27,693	B. H. Yates	Portsmouth Aero Club	22.10.51
27,694	M. Jubb	Spalding Aero Club	22.10.51
27,695	B. G. Leigh	Liverpool Flying Club	22.10.51
27,696	G. M. Jones	R.A.E. Aero Club	22.10.51
27,697	F. R. Mason	Plymouth and District Aero Club	22.10.51
27,698	D. Apostolopoulos ...	No. 25 R.F.S.	22.10.51
27,699	R. M. Carr	R.A.E. Aero Club	22.10.51
27,700	I. M. Mitchell ...	Portsmouth Aero Club	25.10.51
27,701	R. A. Mackey ...	Fair Oaks Aero Club	25.10.51
27,702	N. J. Thomas ...	West London Aero Club	25.10.51
27,703	P. J. Harrington ...	Qualified Service pilot	25.10.51
27,704	O. A. Lines	Qualified Service pilot	25.10.51
27,705	R. E. Badger	Lympne Flying Club	29.10.51
27,706	E. R. Humphries ...	Midland Aero Club	29.10.51
27,707	R. J. Knight	Coventry Aero Club	29.10.51
27,708	J. M. O'Shea	Coventry Aero Club	29.10.51
27,709	T. Wolstenholme ...	Qualified Service pilot	29.10.51
27,710	K. E. Wardill ...	R.A.F., Syerston	29.10.51

SERVICE AVIATION

Royal Air Force and Naval Aviation News



ON THE ACCELERATOR: A Firefly of No. 817 Squadron, on board the Australian carrier H.M.A.S. "Sydney," about to take off for operations over Korea. In the background is a Sikorsky helicopter on loan from the U.S. Navy for use on board the carrier.

Progress with "Eagle"

THE newly commissioned carrier H.M.S. *Eagle*, having finished her harbour tests at Plymouth, left on November 14th for the Clyde area, whence she will put to sea daily for further manoeuvrability and machinery trials.

H.M.S. *Eagle*, 45,000 tons, is our largest carrier and is of 803ft overall length. She will go into full commission with the Navy next spring, when she will embark her squadrons and bring the present complement of 1,400 personnel up to about 2,000.

H.M.S. *Ark Royal*, a sister carrier, is expected to be ready by the end of 1953.

George Medal

THE *London Gazette* of November 13th announced the award of the George Medal to F/L. F. J. Ensell, M.B., Ch.B., an R.A.F. medical officer stationed at Biggin Hill, Kent.

The citation reads: "On August 23rd, 1951, a Harvard aircraft crashed into some dispersal pens on the edge of the airfield at Biggin Hill, and immediately burst into flames. The pilot, who was seriously injured, was trapped in the cockpit. F/L. Ensell arrived with the ambulance and, despite the extreme danger to himself, went to the rescue of the trapped pilot. It was obvious that in his excited, half-conscious state the pilot would be difficult to extricate. Acting calmly and without hesitation, F/L. Ensell administered morphia to the pilot and as soon as this had quietened him, dragged him out of the cockpit, thereby saving his life. The whole of the interior of the aircraft was blazing furiously, the cockpit was full of smoke and flames and there was an immediate danger of the petrol tank exploding. F/L. Ensell stood beside the cockpit with the flames all round him and worked with completely calm efficiency at his rescue task. His shoes were badly scorched and his uniform ruined. F/L. Ensell acted with great bravery and with no thought for his personal safety and set an example of courage and devotion to duty of the highest order in risking his life to save that of a comrade."

F/L. F. J. Ensell, who has been awarded the George Medal. (see accompanying news item.)

Arising out of the same incident, A/C.1. W. S. Cutmore and A/C.1. R. N. Nott, both of whom are airfield firemen, have received the King's Commendation for Brave Conduct.

More Air Trooping

ON November 13th Transport Command began the moving of a further 2,000 airmen from Britain to the Suez Canal Zone. The operation was expected to take about ten days, employing four Handley Page Hastings each day. Relief crews were taking over at Malta.

Seating accommodation on the return flights was made available to Service men's families wishing to come back to Britain.

A. V-M. V. E. Groom, A.O.C. No. 205 Group, M.E.A.F., had asked for, in all, some 5,000 airmen to replace the 12,000 absentee Egyptians normally employed by the R.A.F. in the Canal Zone. Arrangements are already in hand to transport a further 1,000 men by air and it is possible that the final 2,000 will go by the same means.

Branch Commissions

UNDER a system which will come into force next year, warrant officers and chief technicians of the main ground branches of the R.A.F. may be offered permanent commissions as branch officers. They will be appointed in the rank of flying officer and eligible for promotion up to squadron leader. Generally speaking, the selection will be made from those who have at least two years' seniority and specialize in work appropriate to their previous trade qualifications.

The pay of branch officers will take account of their long-service experience and the age of appointment; in the ranks of flying officer and flight lieutenant, therefore, it will be higher than the standard rates. On commissioning, a branch flying-officer will receive 30s. a day, compared with the standard 19s. 6d. flying-officer rate, and the 26s. of a warrant officer with

ON THEIR MARKS: Twenty-four Gloster Meteor 8s ranged for take-off in pairs at Linton-on-Ouse.

"Flight" photograph

SERVICE AVIATION . . .

four to eight years' seniority of service.

Branch officers will be eligible for retired pay and for the terminal grant of £1,000. The scheme is fully applicable to members of the Women's Royal Air Force, with proportionate differences in pay.

Existing arrangements whereby outstanding airmen and airwomen under the age of 30 may be selected for normal permanent commissions will be retained.

Vampire Trainers for R.A.A.F.

THE Australian Air Minister, Mr. McMahon, has announced the ordering of a number of D.H.115 (Vampire Trainer) aircraft for the Royal Australian Air Force. The size of the order was not stated, but he did say that the type would later be manufactured in Australia.

With its side-by-side cockpit layout the 115 can be regarded as a two-seat Vampire 5, powered by a Goblin 3. A full description appeared in *Flight* of November 23rd, 1950.

R.C.A.F. Appointment

IT has been announced that A. Cdre. H. Godwin, C.B.E., O.B.E., C.D., who is now in charge of Plans and Intelligence at R.C.A.F. Headquarters, will take over as A.O.C. Air Materiel Command on the retirement of A. V-M. R. McBurney, C.B.E., C.D., in January next. For his new appointment A. Cdre. Godwin will be promoted to Air Vice-Marshal.

Air Marshals' Club

THE Air Marshals' Club met on Friday last, November 16th, at luncheon in the Connaught Rooms, London. The Chief of the Air Staff, Marshal of the Royal Air Force Sir John Slessor, presided. Those present included Marshals of the Royal Air Force the Viscount Trenchard, Sir John Salmond, and Sir Edward Ellington; Air Chief Marshals Sir Robert Brooke-Popham, Sir John Steel, Lord Dowding, Sir Edgar Ludlow Hewitt, Sir Arthur Longmore, Sir Frederick Bowhill, Sir Christopher Courtney, Sir Douglas Evill, Sir Norman Bottomley, Sir James Robb, Sir Ralph Cochrane, Sir Alec Coryton, Sir William Dickson and Sir Arthur Sanders.

REUNION PARTY: Air Chief Commandant the Duchess of Gloucester, with Dame Mary Welsh, arriving at Londonderry House for the fourth annual reunion of the W.A.A.F. and W.R.A.F. officers. Air Commandant Nancy Salmon, Director of the W.R.A.F., welcomed the guests.

African Jet-fighter Route

A FEATURE of the recent ceremonial opening of Entebbe Airport, Uganda, was a display (see pages 650-651 of this issue) by R.A.F. Vampires engaged on surveying a jet-aircraft staging-route between the Canal Zone and South Africa. This central route—which, when used for reinforcing the Middle East, would of course be flown in a northerly direction—was selected after earlier exploratory flights in which a coastal route had been examined.

Other aircraft besides Vampires are engaged on the flight, which started from R.A.F. station, Shallufa, between Fayid and Suez, on November 5th, when Air Marshal Sir John Baker, A.O.C.-in-C., M.E.A.F., addressed the crews. From Shallufa they flew south *via* Wadi Halfa, Khartoum, Juba and Entebbe, where three of the four Vampires took part in the display mentioned above.

Their route then lay *via* Tabora (Tanganyika), Kasama, Lusaka, Livingstone (Southern Rhodesia) to Swartkop, near Pretoria, where liaison with the S.A.A.F. was being made. On the return route certain alternative airfields are being examined, including Salisbury, N'Dola and Eastleigh.

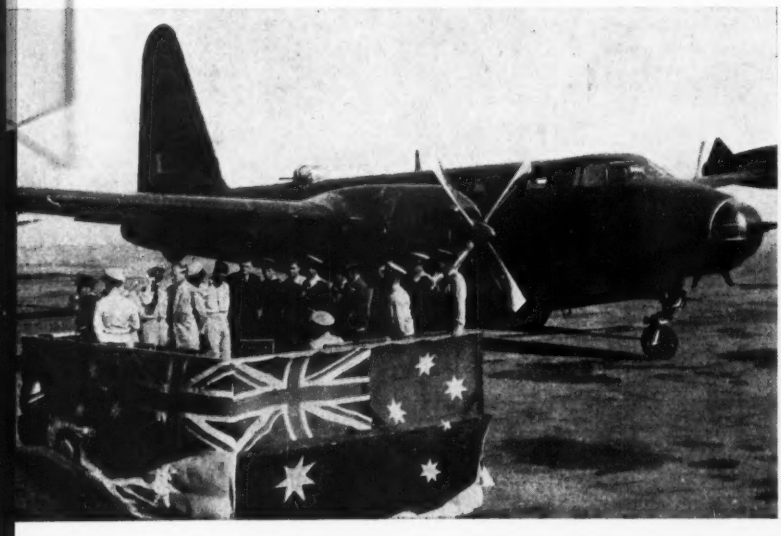
In all, eleven aircraft are engaged, there being, in addition to the Vampires, two Mosquitoes and five Valettas.

The force commander is S/L. P. G. Leggett, with F/L. L. W. F. Stark, D.F.C. and Bar, A.F.C. (an ex-Boscombe Down test pilot) as his deputy; F/L. Stark leads the Vampire formation, the other three jet pilots being F/O. Harvey, M.Plt. J. Fisher and Sgt. Collinson. Two Czechs, F/L. Mansfeld (navigation leader) and F/O. Lastovka, form the crew of one Mosquito, while the other is manned by Sgt. Spokes and Sgt. Bruce-Smith. The Mosquitoes, flying in advance of the jets, act as navigation leaders by visual and/or R/T. contact.

On each leg, No. 1 Valetta (F/S. Watson) with F/L. Bainbridge, senior air-traffic control officer for the Vampires, goes on in advance to organise R/T. and homing facilities, a portable H.F. homing transmitter being carried for the latter purpose. The other four Valettas, carrying ground crews, spares and all the other miscellaneous equipment necessary on an enterprise of this kind, are captained respectively by F/L. Gray (i/c transport aircraft), F/L. Jordan, F/S. Brown and Sgt. O'Brien.

Apart from its potential strategic value, the flight—which has been performed without adverse incident up to the time of writing—is noteworthy in that it proves conclusively the ability of the modern jet fighter to "fly anywhere."

FIRST ARRIVALS: On November 9th two Lockheed Neptunes landed at Richmond, N.S.W., from San Francisco. They are for No. 11 Squadron, R.A.A.F., which will complete its re-equipment as further Neptunes arrive. The crews were welcomed by A.V-M. J. P. McCauley, C.B., C.B.E., A.O.C. Eastern Area.



R.N.V.R. Commissions Ex-ratings

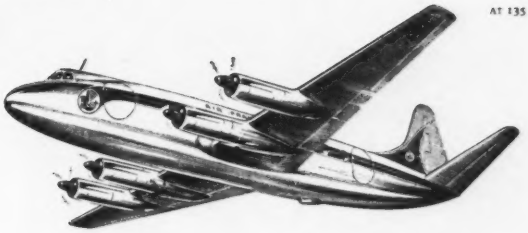
SUBJECT to a satisfactory interview by a selection board, the Admiralty announces that ex-rating pilots, trained up to wings standard in the last war, may be given commissioned rank in the R.N.V.R. On acceptance they will be posted to one of the three fighter or two anti-submarine squadrons as probationary acting lieutenants if over 25 years of age, or as probationary acting sub-lieutenants if below that age.

Canal Zone Gliding Club

SINCE the formation of a gliding club at Kabrit in the Canal Zone in April last, over 450 officers and airmen have flown in its aircraft, a number taking their "A" and "B" Certificates. A Kirby Cadet is available and a Kirby Tutor is expected to go into service shortly.

G/C. J. O. W. Oliver, the Station Commander, is president, and F/L. M. Turner, the C.F.I., is assisted by S/L. L. V. Bachellier, Major D. B. White and F/L. P. I. Hart.

AT 135



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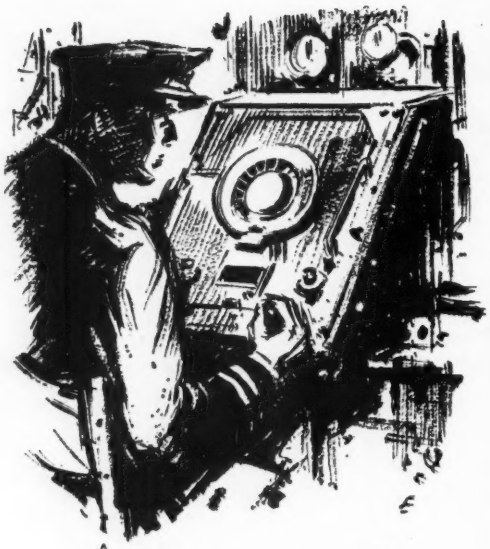

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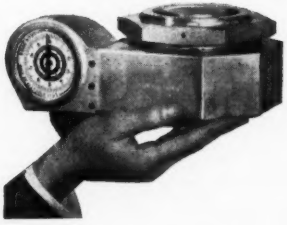

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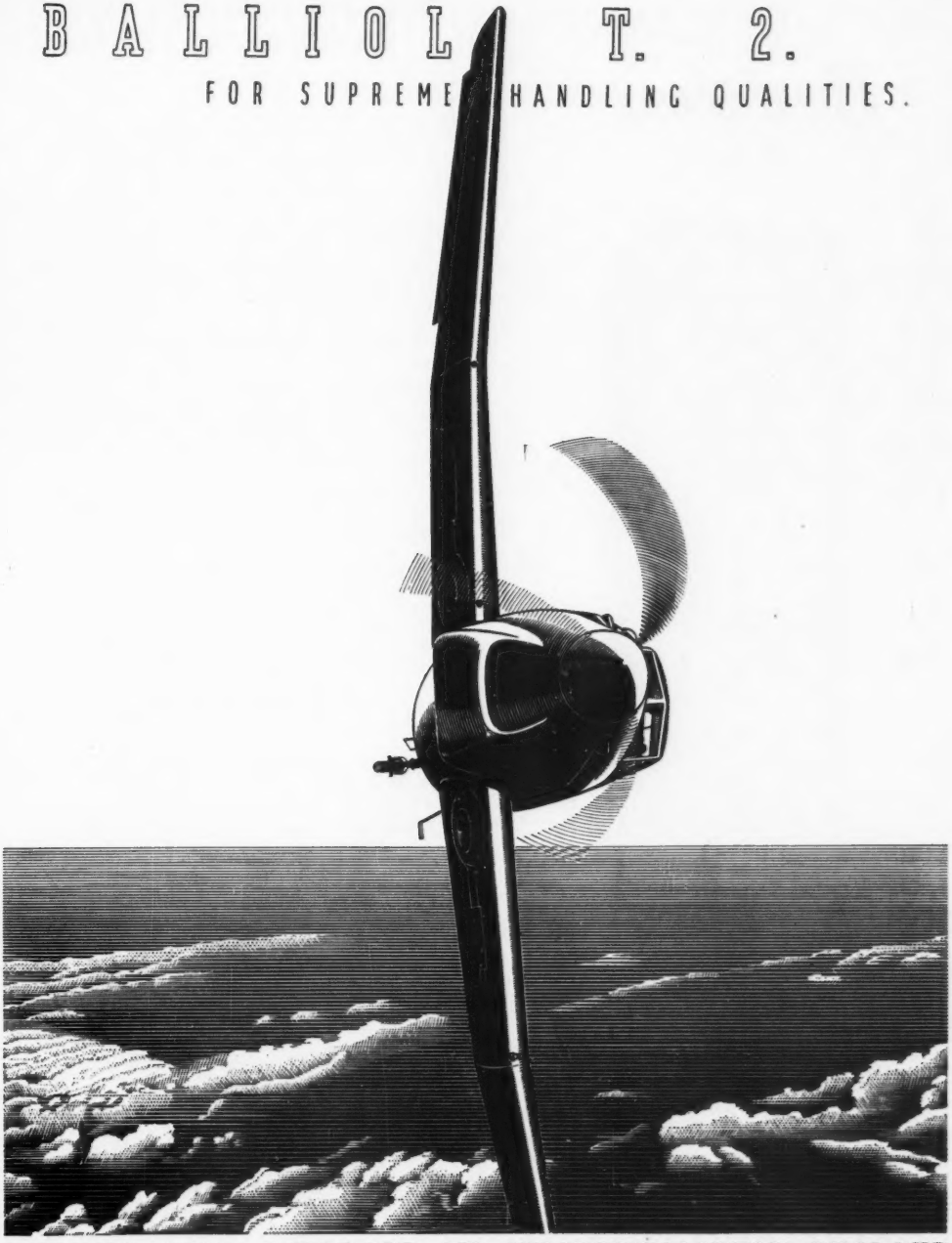

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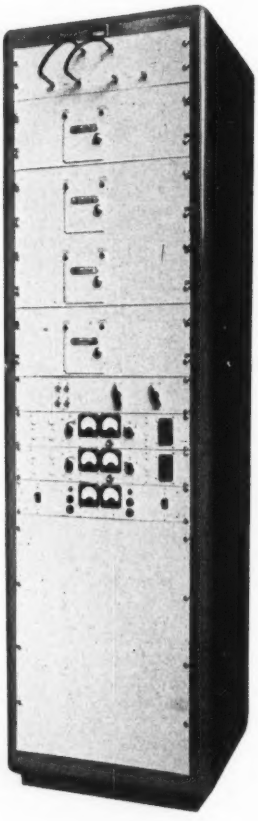

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THE DE HAVILLAND AIRCRAFT CO., LTD.,
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Applications, stating age, experience and salary required, to:—
CHIEF DRAUGHTSMAN,
THE DE HAVILLAND AIRCRAFT CO., LTD.
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THE DE HAVILLAND AIRCRAFT Co.; Ltd., Hatfield, have the following vacancies:
SENIOR DESIGN DRAUGHTSMEN FOR SPECIAL INSTALLATIONS OF EQUIPMENT, INTERIOR LAY-OUTS AND FURNISHING OF CABINS
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TECHNICAL ILLUSTRATORS FOR MAINTENANCE MANUAL WORK

APPLY in writing, stating experience, age, and salary required, to Chief Draughtsman, the de Havilland Aircraft Co., Ltd., Hatfield, Herts. [7152

NORMALAIR LIMITED, Yeovil, Somerset require:—
Designers
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FOR design, development, etc., of aircraft air conditioning and high altitude breathing equipment.

APPLICATIONS, giving age, experience, qualifications and salary required, to Personnel Officer. Local interviews arranged for selected applicants. [7254

VICKERS-ARMSTRONGS, Ltd., (Aircraft Section), have vacancies at Burn Airport for the following staff:—
DESIGN DRAUGHTSMEN
(aircraft experience preferable, but not essential).
AIRCRAFT STRESSMEN
JIG AND TOOL DRAUGHTSMEN
(aircraft experience preferable, but not essential).

APPLY, in writing, to the Employment Manager, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge, Surrey. [7163

DE HAVILLAND AIRCRAFT CO., LTD. (Airspeed Division), Christchurch, Hants, have vacancies for the following technical staff:—
Aerodynamicists, Senior and Junior.
Weight Control Personnel.
Instrument Engineer to take charge of the Instrument Laboratory.

PENSION and superannuation schemes in operation.—Apply to Personnel Manager. [7272

HANDLEY PAGE, Ltd., have vacancies for:

AERODYNAMICISTS of degree standard or with H.N.C. in aero subjects. Previous experience preferred.

WIND tunnel technicians of degree standard or with H.N.C. in aero subjects. Previous experience preferred.

STRESSMEN of degree standard or with H.N.C. in aero subjects. Previous experience preferred.

WEIGHTS control engineers with minimum qualifications of O.N.C. Previous experience preferred.

SENIOR design and intermediate draughtsmen, preferably with aircraft experience for Cricklewood and Radlett offices. Consideration will be given to applicants with experience in light structural or mechanical engineering. Possession of I.N.C. or H.N.C. (Mech. or Elect.) an advantage.

LOFTSMEN with previous experience of full scale layout work or similar workshop practice.

TECHNICAL authors, preferably with experience in the preparation of maintenance manuals, pilots' notes, technical specifications, etc.

TECHNICAL illustrators with previous experience in aircraft work. Write, stating age, qualifications and details of experience, to: Staff officer, Handley Page, Ltd., Cricklewood, London, N.W.2. [7211

WESTLAND AIRCRAFT, Ltd., have vacancies for the following:—

STRESSMEN, intermediate and senior.

DRAUGHTSMEN, intermediate and senior.

SPARES COMPILERS.

APPLY, stating age, qualifications, experience and salary required, to Personnel Officer, Westland Aircraft, Ltd., Yeovil, Somerset. [7078

WESTLAND AIRCRAFT Ltd., Yeovil, Somerset, require:—

SENIOR, intermediate draughtsmen and stressmen.

APPLICANTS should state age, experience, qualifications and salary required, to the Personnel Officer. [7253

THE ENGLISH ELECTRIC Co., Ltd., Luton, have the following vacancies on guided weapon projects:

RESEARCH engineer (Ref. 441B) for work on planning and analysis of supersonic flight tests. Applicants should have a degree, H.N.C. or equivalent qualification. Previous experience of stability and control work an advantage.

AERODYNAMICS engineer (Ref. 457A), with degree in aeronautical engineering, for work on supersonic aerodynamics. A good knowledge of mathematics, particularly calculus, is essential. Previous experience in industry not necessary.

STRUCTURAL engineer (Ref. 845) as assistant on structural research and design on supersonic project. H.N.C. or recognised diploma in appropriate subjects. Practical experience in design and stressing of aircraft structures an advantage.

APPLICATIONS, stating age, technical qualifications and experience, to Central Personnel Services, 24 Gillingham Street, London, S.W.1, quoting appropriate reference. [7194

OLLEY AIR SERVICE have vacancies for pilots with current senior commercial and instrument rating. Commencing provisional salary £1,200 with increments.—Apply Croydon Airport. [7220

SITUATIONS VACANT

THE DE HAVILLAND AIRCRAFT Co., Ltd., Airspeed Division, Christchurch Aerodrome, Hampshire, have vacancies for the following staff:—

AERODYNAMICISTS, senior and junior.

WEIGHT control personnel.

WRITE, giving details of age, experience, and salary required, to Personnel Manager. [7246

APPLICATIONS are invited from design draughtsmen and stressmen; also technical assistants with combined design and performance experience for work on both reciprocating and gas turbine aero engines.

APPLICATIONS should state full particulars of experience and qualifications, and should be addressed to The Personnel Manager, The de Havilland Engine Co. Ltd., Stonegrove, Edgware, Middlx. [0575

JIG and tool draughtsmen required. Previous aircraft experience not essential.—Apply Employment Manager, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge, Surrey. [7204

AIRCRAFT radio mechanic required, preferably but not essentially experienced on V.H.F. equipment.—Apply: Airwork, Ltd., R.N.A.S., Brawdy, Pembs, S. Wales. [7293

LICENCED radio engineer and radio mechanics at our base at Stansted Airport, Essex.—Apply, by letter or telephone, to the Senior Radio Engineer, Aviation Traders Ltd., Southend Airport, Essex. Tel.: Rochford 56491. [0590

JIG and tool draughtsmen required, fully experienced. —Applications, in writing, to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Beds., stating age, experience and salary required. [0593

PLANNERS required, preferably with aircraft experience. —Write full particulars to Personnel Department, Vickers-Armstrongs, Ltd., South Marston Works, Swindon, Wilts. [7268

AERODYNAMICS assistant required for interesting work. — Applications in writing, stating age, qualifications, experience and salary required, to Chief Designer, Auster Aircraft, Ltd., Rearsby Aerodrome, Leicester. [7269

PERMANENT post, with good salary and conditions, is offered to a pilot holding Senior Commercial (Rapide Endorsement) and R/T Licences.—Apply: Jersey Airlines, 4, The Parade, Jersey, Channel Islands. [7190

WANTED: Air traffic control officer for an aerodrome in the South Midlands, necessary qualifications being R.A.F. Home Command Approval, or equivalent standard Commencing salary, £475 p.a.

APPLY: Goodhew Aviation Co., Oxford Airport, Kidlington, Oxford.

PUBLICATIONS are invited by the Ministry of Supply for the following posts in the Naval Aircraft Department of the Royal Aircraft Establishment, Farnborough, Hants.

(1) SENIOR SCIENTIFIC OFFICER. To lead a section in special investigations, chiefly concerning Naval aviation and related mechanical problems. (Ref. C668/51/A)

(2) SCIENTIFIC OFFICER. For work connected with out-of-door instrumentation. Experience of electronics and electrical methods of measurement is desirable. (Ref. A341/51/A)

Candidates should have a first- or second-class honours degree in physics or mechanical engineering. For post (1) they must be at least 26 years of age and have had at least three years' post-graduate research experience, preferably in aviation research. Salary will be assessed according to qualifications and experience within the ranges: Senior scientific officer, £720 to £910, scientific officer, £380 to £620. Rates for women somewhat lower. Posts carry benefits of F.S.S.U.

(3) EXPERIMENTAL OFFICERS. Mechanical engineers assist with the development of special flight-deck equipment for Naval Aircraft. Some experience in experimental or development work on structural or mechanical equipment and in structural strength testing is essential. Candidates, who must be at least 28, should have Higher National Certificate in mechanical engineering with a sound knowledge of strength of materials, theory of structures and applied mechanics. (Ref. C668/51/A)

(4) ASSISTANT EXPERIMENTAL OFFICER. Physicist to carry out electronic methods of measurements, in which work initial training will be given. Candidates should have Higher School Certificate in physics and mathematics with an interest in experimental work. (Ref. A342/51/A)

Salaries will be assessed according to age, qualifications and experience within the ranges: Experimental officer, £545 to £695, assistant experimental officer, £290 (at age 18) to £505. Rates for women somewhat lower. All posts are unestablished.

APPLICATION forms obtainable from Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26, King Street, London, S.W.1, quoting appropriate reference number. Closing date: December 8, 1951. [7261

AIRCRAFT fitter assemblers required by de Havilland Aircraft Company, Hatfield. Good working conditions, modern equipment, superannuation scheme, opportunities for advancement.—Apply in person or by letter to Personnel Manager, or telephone Hatfield 2345. [0930

TECHNICAL assistant required for design study section of aircraft company located in Bedfordshire. Principal duty will be aircraft performance estimation, but other work of a varied and interesting nature is entailed.—Apply with full details, quoting ref. M.5, to Box 5235. [7260

THE MINISTRY OF SUPPLY requires, at research and other establishments in various parts of the country, skilled mechanics for precision light engineering work connected with the setting up, maintenance, and repair of instruments (mechanical, electrical and electronic).

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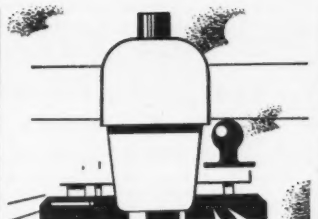
WRITE in the first instance, giving age, particulars of apprenticeship, training (including Forces' training), qualifications and experience, also stating whether preference for a particular district, to the Secretary, Ministry of Supply, Room 263, Shell Mex House, Strand, London, W.C.2.

APPLICATIONS from skilled fitters and machinists would also be welcomed. [7262

SCHEDULE clerks required (male) with experience in compiling M.O.S. spares schedules.—Applications, in writing, stating age, experience and salary required, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds. [0596

TECHNICAL authors and illustrators required. Knowledge of M.o.S. procedure desirable.—Applications, in writing, stating age, experience and salary required, to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Beds. [0594

SENIOR, intermediate and junior mechanical draughtsmen wanted for aircraft work. Previous aircraft experience not essential. Pension and life assurance scheme.—Apply: Employment Manager, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge. [6920



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LOFTSMEN, Junior, intermediate and senior—required for aircraft mould loft. Previous aircraft experience not essential.—Apply, Employment Manager, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge, Surrey. [7203

SENIOR and junior weight engineers required. Interesting work on new projects. Permanent positions offered to suitable applicants.—Apply, stating age, experience, qualifications and salary required, to Chief Designer, Gloster Aircraft Co., Ltd., Witcombe, Glos. [0912

GLOSTER AIRCRAFT Co., Ltd., have vacancies for fully experienced aircraft structural and electrical draughtsmen.—Applications, in writing, stating age, experience and salary required, to Employment Officer, Gloster Aircraft Co., Ltd., Hucclecote, Glos. [0910

VACANCIES for draughtsmen and stressmen exist in the Saunders-Roe Helicopter Division at Eastleigh, near Southampton.—Interested persons should write, stating age, experience, qualifications, salary required, etc., to the Personnel Officer, Saunders-Roe, Ltd., East Cowes, Isle of Wight. [7141

ENGLISH ELECTRIC have vacancies in their London Design Office for aircraft stressmen.—Suitably qualified men, having structural stressing experience, should write, giving full details and quoting Ref. 903A, to Central Personnel Services, English Electric Co. Ltd., 24-30, Gillingham Street, London, S.W.1. [7241

TECHNICAL clerk required, with experience of Ministry of Supply D.I.S. procedure, knowledge of spares provisioning would be an asset. First-class working conditions and good salary offered.—Apply, Personnel Department, Joseph Lucas (Gas Turbine Equipment) Ltd., Shaftmoor Lane, Hall Green. [7274

DRAUGHTSMEN, senior and junior mechanical engineering draughtsmen urgently required, also a lady tracer. Ring or write Personnel Superintendent at Blackburn and General Aircraft Company, 121, Brough. Ext. 133. The Labour Office is opened on Saturdays. Fares refunded to applicants calling at Brough for interviews. [7248

THE de Havilland Aircraft Co., Ltd., Airspeed Division, Christchurch Aerodrome, Hampshire, require a metallurgist. Work embracing control, material testing and kindred developments. Applicant with broad experience preferred.—Write, stating age, qualifications and salary required, to the Personnel Manager. [7202

PLANNING engineers and progressmen required. Considerable production planning experience and sound knowledge of metal airframe components manufacture essential.—Applications in writing to Personnel Manager, Percival Aircraft Ltd., Luton Airport, Beds., stating age, experience and salary required. [7273

DOWTY EQUIPMENT, Ltd., aircraft hydraulic engineers, Arle Court, Cheltenham, require stressmen. The factory is ideally situated and the environment and working conditions are excellent. Pension scheme, five-day week.—Write Personnel Manager, stating age, qualifications and salary expected. [0803

SURREY FLYING SERVICES Ltd. urgently require aircrew for "York" aircraft, flight navigators. Radio officers must be in possession of current licences. Corporation rates of pay.—Apply by letter or 'phone, Surrey Flying Services, Ltd., 78 Buckingham Gate, S.W.1. Tel.: Whitehall 0056. [0951

APPLICATIONS are invited from senior and intermediate design draughtsmen; experience of aero engine design, desirable but not essential.—Please write stating age and giving details of previous experience in chronological order to the Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [0949

ONE male test laboratory assistant required. National Certificate standard and preferably 2-3 years' experience on design and analysis of mechanical tests.—Applications in writing, stating age, experience and salary required, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds. [0597

SIX experienced aircraft senior draughtsmen are currently required for interesting programme of development work. Excellent conditions and attractive rates for the right men.—Write to the Chief Designer, Helliwells, Ltd., Walsall Airport, for interview, giving full details of age and experience. [7155

H. M. HOBSON, Ltd., invite applications for positions in the drawing office as follows: designers, detail and modification draughtsmen, checkers, stressmen. The work is concerned with interesting projects connected with fuel metering equipment and hydraulic flying controls for aircraft.—Hobson Works, Fleetsbridge, Bournemouth. [0420

DRAUGHTSMEN. Design, detail and checkers required for work on gas turbine fuel systems. Experience in light hydraulics an advantage but not essential. Good salary, excellent conditions. Pension scheme.—Apply Joseph Lucas (Gas Turbine Equipment), Ltd., Shaftmoor Lane, Hall Green, Birmingham. [7232

STRESSMAN—section leader required for work on new project. Fuselage stressing experience desired. Assistance in finding initial accommodation. Applications, stating age, salary required and details of experience and qualifications, to Personnel Manager, Boulton Paul Aircraft, Ltd., Wolverhampton. [7231

APPLICATIONS are invited for the vacancy at Wig Bay, Stranraer, Scotland, in control of about 150 employees engaged in production, and other work ancillary to large aircraft. Applicants must possess good experience of general administration; and practical experience also of the maintenance, equipment, inspection and minor overhaul of Sunderland aircraft. [7270

APPLICATIONS, in writing only, to Personnel Manager, Short Brothers and Harland, Ltd., Queen's Island, Belfast. [7265

APPLICATIONS are invited for the following positions in the London area: Draughtsmen required for detail drawing of experimental designs of aircraft electrical equipment. Works experience essential.—Write for full details in strictest confidence to the Employment Officer, Rotax, Ltd., Chandos Road, Willesden Junction, N.W.10. [7271

SALARY £900 to £1,200 a year according to qualifications offered for electrical designer, aged 30-40, required with 1st- or 2nd-class Honours degree to be responsible for the control of a department developing and exploiting electrically operated valves and other light electrical equipment for aircraft and industrial purposes. Experience of servo controls an advantage.—Box 4923. [7278

THE GLOSTER AIRCRAFT Co. requires senior and intermediate stressmen to work on designs and projects of advanced interest. Excellent prospects of advancement for sound and energetic men.—Apply, in the first instance, giving full particulars of technical qualifications, age, experience and salary required, to The Chief Designer, Gloster Aircraft Co., Ltd., Hucclecote, Glos. [0911

ARMSTRONG SIDDELEY MOTORS have vacancies in their Coventry factory for senior and intermediate jig and tool draughtsmen to work on both the gas turbine aero engine and car production. This is work of national importance and the right men will be suitably rewarded. —Please reply in some detail, to Reference JTD, Armstrong Siddeley Motors Limited, Coventry. [7235

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SITUATIONS VACANT

THE FAIREY AVIATION Co., Ltd., require stress analysts and aerodynamicists for a number of interesting and varied projects on fixed and rotary wing aircraft. Good salaries and promotion prospects. Superannuation scheme.—Apply in writing with full details of experience, etc., to the Personnel Manager, Hayes, Middlesex, quoting Reference TO/A3. [7156

AIR FORCE, Naval, civil and helicopter aircraft all under design and development at Percival Aircraft, Ltd. Applications are invited from senior and junior draughtsmen, and stressmen, for work on this interesting programme.—Write, giving details of experience and salary required to Personnel Manager, Percival Aircraft, Ltd., Luton Airport, Luton, Beds. [0695

FLIGHT REFUELLING, Ltd., require a junior technician in their performance office for the mathematical analysis of aircraft fuel requirements. Minimum qualification.—G.C.E. Some previous experience of technical work an advantage, but not essential.—Apply, giving details of age and qualifications, to Personnel Manager, F.R.L., Tarrant Rushton Airfield, near Blandford, Dorset. [7230

FLIGHT test observers and aerodynamicists, capable of performance reduction and analysis and preparation of reports, required for programme of civil and Service aircraft development. Good prospects for keen workers.—Apply, giving full particulars of training, experience, age and salary required, to Personnel Manager, Percival Aircraft, Ltd., The Airport, Luton, Beds. [0672

PLANNING engineers urgently required. Must be thoroughly experienced in planning and production of light engineering and aircraft components, including sheetmetal work, detail fitting shop and press shop. Good opportunities and pleasant working conditions.—Apply, giving full details of previous positions and experience, to Personnel Manager, Scottish Aviation Ltd., Prestwick Airport, Ayrshire. [7229

TECHNICAL assistants, both junior and senior, required in mechanical engineering department for work of national importance in connection with development of gas turbine engines. Excellent prospects exist in sections dealing with rig test of engine components, vibration, static structure test and research in gears and bearings. Qualifications: degree or H.N.C.—Apply: Reference No. VI, Armstrong Siddeley Motors, Ltd., Coventry. [0952

INSTALLATIONS Supervisor required. Applications are invited from men with experience of maintenance and test of small electronic and electro-mechanical devices. Additional mechanical knowledge an advantage. Qualifications: H.N.C. standard.—Write, stating age, experience and salary required, to Personnel Manager, Sperry Gyroscope Co., Ltd., Great West Road, Brentford, Middlesex. [7256

AERO CONTROLS, Ltd., Northampton, have the following vacancies in their design office: senior and intermediate design draughtsmen for special structural and control installation work of high priority; also stressmen required for work on new and existing projects.—Write, stating age, experience and qualifications to Chief Engineer, Industrial Estate, Weedon Road, Northampton. [7259

AIRCRAFT draughtsmen are required by the English Electric Co., Ltd., for employment at Warton and Acton, London. Men with good aircraft structure or jet engine installation and fuel system experience should write, giving full details of their qualifications and experience, quoting Ref. 2103 to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham Street, London, S.W.1. [7275

D. NAPIER AND SON, Ltd., have vacancies for young technical assistants for analysis of experimental engine test results and performance work in connection with the development of high-speed I.C. engines. Applicants with at least O.N.C. and preferably with experience of similar work should write stating age, experience, qualifications and salary, quoting ref. 455, to Central Personnel Services, English Electric Co., Ltd., 24-30, Gillingham Street, London, S.W.1. [7252

AN instrument mechanic is required for duties in the electronic section of the Research and Experimental Department. Applicants should possess a high degree of mechanical skill, and be able to participate intelligently in both design and manufacture of small electro-mechanical devices. Experience in a similar capacity, whilst desirable, is not essential.—Write, stating age, experience, and salary expected to the Personnel Officer, Saunders-Roe, Ltd., East Cowes, I.O.W. [7265

APPLICATIONS are invited for the following positions in the London area:—Development engineers required by manufacturers of a.c. and d.c. electrical equipment for aircraft. Applicants should hold at least a Higher National Certificate or preferably an Engineering Degree. The positions are superannuated and give considerable scope to men with adequate experience.—Write, giving full details in strictest confidence, to the Employment Officer, Rotax, Ltd., Chandos Road, Willesden Junction, N.W.10. [7270

CHIEF technician with 1st- or 2nd-class Honours degree in engineering or mathematics required, age 30-40, salary £1,000 to £1,500 according to experience. Must have responsible experience in aircraft stress office work and in dealing with other technical problems associated with aircraft design. Successful applicant will be responsible for stress office and technical office and generally for the study of the performance of airframe components and the investigation of associated problems.—Box 6932. [7199

STRESS engineers required by progressive firm in the Midlands for the stress analysis of new rocket aircraft projects. The positions offer exceptional opportunities of entering a new expanding branch of aviation and have good prospects. Applicants should have experience of stressing either of aircraft or engines or civil structures. A degree in engineering would be preferred but not essential qualification. The Company has good welfare and social facilities.—Apply, stating age, experience, to Box 4926. [7187

SITUATIONS VACANT

ENGINEERS, having experience of aircraft fuel systems and associated equipment, are invited to make application regarding a vacancy for a project engineer in a develop nent department in the south of England. The post, which is permanent, involves responsibility for layout and design work in the application of equipment to prototype and production aircraft; also liaison with other project engineers. Whilst experience of aircraft installations and equipment is essential, some knowledge of instrumentation and electrical equipment is required. The salary offered will be commensurate with qualifications and experience.—Write, giving full details of experience, etc., to Box 5313. [7262

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SITUATIONS VACANT

ARMSTRONG SIDDELEY MOTORS have a few vacancies for senior and junior stressmen to do work on strength investigations and calculations on gas turbine aero engines. Degree, Higher National Certificate or equivalent essential. This is work of prime national importance. There are also a few vacancies for senior and junior stressmen for work on the installation of gas turbines in aircraft.—Apply in some detail to Reference S/38.1. [7260

THE GLOSTER AIRCRAFT Co. requires the services of a number of aerodynamicists, (a) for design and project work, and (b) for flight test reduction. Opportunity exists for individuals to vary their experience within the Aerodynamics Department. Candidates with some years' experience preferred, but applications from juniors with sound mathematical ability will receive full consideration. —Apply, in the first instance, giving full particulars of age, experience and salary required, to The Chief Designer, Gloster Aircraft Co., Ltd., Hucclecote, Glos. [0913

FIELD trials assistants. Applications invited, interesting appointments connected with trials of new project. Successful applicants required to travel (London and West Wales). Experience in small electronic, electro-mechanical or hydraulic devices necessary. General experience in the field essential. Ex-Service artificer grades with suitable experience would be considered.—Write, stating age, experience and salary required, to the Personnel Manager, Sperry Gyroscope Co., Ltd., Great West Road, Brentford, Middlesex. [7287

TECHNICAL assistant required to undertake technical administrative duties. An orderly mind and ability to write concise reports are essential. A degree or Higher National Certificate and general experience in aircraft engineering are desirable but opportunity exists for man with practical outlook and limited aircraft experience to extend his knowledge of aircraft design.—Applications should be made to the Chief Draughtsman, The English Electric Co., Ltd., Aircraft Division, Warton Aerodrome, Nr. Preston. [7234

CHIEF PLANNING/PRODUCTION ENGINEER required by rapidly expanding company engaged on the manufacture of major aircraft sub-assemblies and associated equipment. The selected applicant would be solely responsible for the organization of the planning, estimating, rate-fixing and progress sections. Excellent prospects for an experienced, keen and energetic man who would be paid a salary commensurate with his qualifications.—Apply, in writing, giving fullest details, including copies of recent references, to Airtech, Ltd., Aylesbury and Thame Airport, Haddenham, Bucks. [7286

AERONAUTICAL and mechanical engineers are invited by the Ministry of Supply to apply for appointments in the scientific officer class, mainly in the aerodynamics and structures departments of the Royal Aircraft Establishment, South Farnborough, Hants. Candidates should have a 1st- or 2nd-class honours degree in aeronautical or mechanical engineering or equivalent qualification. For the senior grade candidates must be at least 26 years of age and have had a minimum of three years' post-graduate research experience. Salary will be assessed according to age, qualifications and experience within the ranges: senior scientific officer, £720 to £910, scientific officer £380 to £620. Rates for women somewhat lower. The posts are unestablished, but carry benefits under F.S.S.U. Application forms obtainable from Ministry of Labour and National Service, Technical and Scientific Register K, Almack House, 26, King Street, St. James's Square, London, S.w.1, quoting C636/51A. Closing date, December 15, 1951.

AERODYNAMICISTS, physicists and engineers are required by Ministry of Supply for immediate vacancies in the scientific officer and experimental officer classes at a research establishment in Hampshire. The work is concerned with problems of heat transfer, aerodynamics, projects and performance in the increasingly important field of gas turbine research. Houses are available to rent for married men and candidates with the qualifications outlined below are asked to make early application for the vacancies. Ref. C.678/51A. Scientific officer class, 1st or 2nd class honours degree or equivalent qualification in the appropriate subject. Grade and salary will be assessed in the following ranges according to age, qualifications and experience (considerable post graduate experience is required from candidates for senior posts). Principal scientific officer (min. age 31), £960 to £1,245. Senior scientific officer (min. age 26), £720 to £910. Scientific officer, £380 to £620. Rates for women somewhat lower. Posts are unestablished but carry benefits under F.S.S.U. Ref. C.679/51A. Experimental officer class. Candidates should possess one of the following qualifications or its equivalent: Higher school certificate, intermediate B.Sc., higher national certificate or a degree. Grade and salary will be assessed in the following ranges according to age, qualifications and experience. Senior experimental officer (min. age 35), £742 to £969. Experimental officer (min. age 29), £515 to £615. Assistant experimental officer, £210 (at age 18) to £505. Rates for women somewhat lower. The posts are unestablished.—Application forms obtainable from Ministry of Labour and National Service, Technical and Scientific Register, (K), Almack House, 26-28, King Street, London, S.W.1, quoting appropriate Ref. No. Closing date, December 8th, 1951. [7278

SITUATIONS WANTED

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